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DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Bethesda, Maryland 20084

MEASUREMENTS OF THE EFFECT OF TRIM ON THE NOMINAL WAKE OF THE NAVAL AUXILIARY OILER AO-177

by

Michael B. Wilson
Gary A. Hampton

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SHIP PERFORMANCE DEPARTMENT
DEPARTMENTAL REPORT

March 1981 DTNSRDC/SPD-0544-19

MEASUREMENTS OF THE EFFECT OF TRIM ON THE NOMINAL WAKE OF THE NAVAL AUXILIARY OILER AO-177

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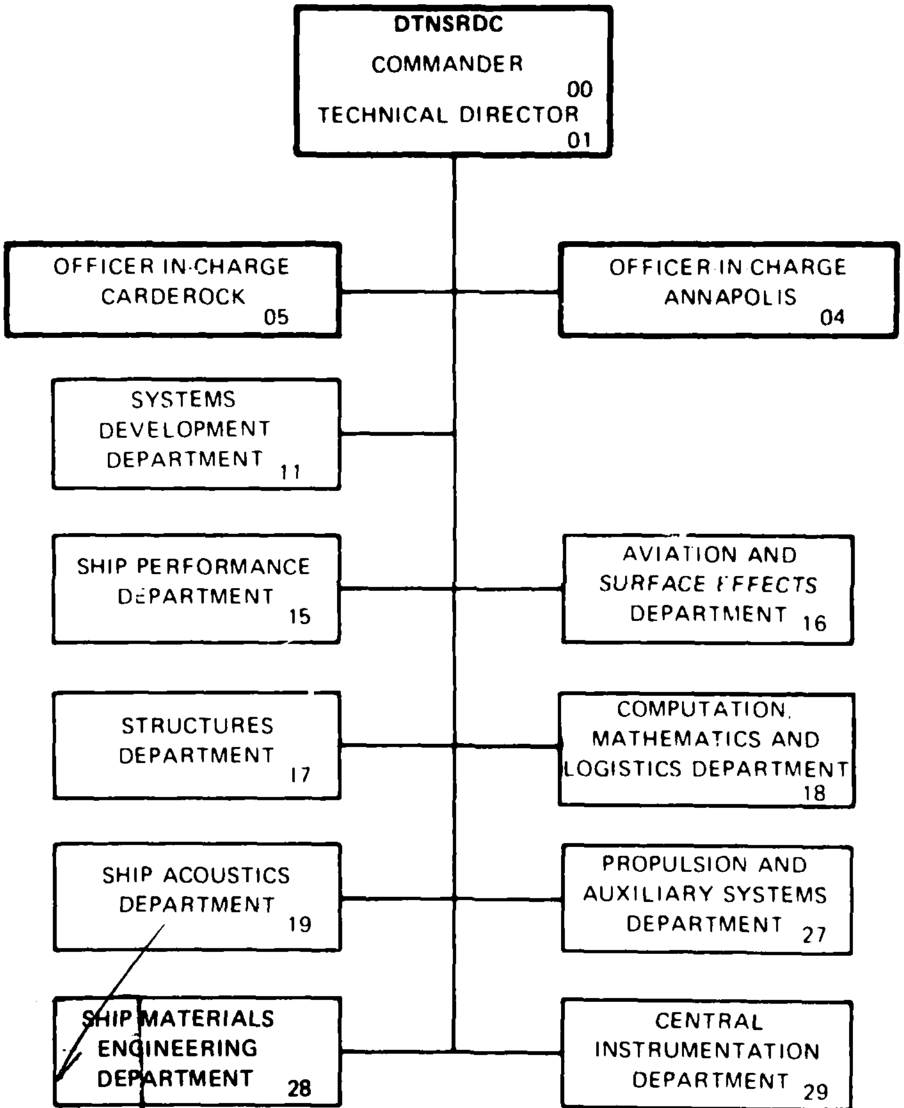

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Wake survey measurements of the nominal wake behind the AO-177 hull have been obtained from model experiments and are presented for cases involving trim variations and a slight change in displacement. Extensive tables and plots of the basic wake data display the three velocity component distributions, summaries of useful averaged wake quantities, and distributions of wake harmonics. Radial distributions of a wake steepness parameter are compared for the various trim conditions, and it appears that any difficulties produced by

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the ship wake are not introduced by the expected changes in trim.

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NOTATION

Conventional Symbol	Symbol Used on Computer Plots	Definition	Units*
A_N	COS COEFF	Cosine coefficient of the N^{th} harmonic	-
B_N	SIN COEFF	Sine coefficient of the N^{th} harmonic	-
C_B		Block coefficient	-
C_P		Prismatic coefficient	-
C_X		Maximum section area coefficient	-
D		Propeller diameter	L
G_W		Wake gradient parameter	-
J_V	JV	Apparent advance coefficient $J_V = V/nD$	-
N	N	Harmonic number	-
n		Propeller rate of revolution(rps)	Rev/T
r/R or x	RAD	Radial distance (r) from propeller axis expressed as ratio to propeller radius	-
r_{hub}		Hub radius	L
R		Propeller radius	L
∇		Ship displacement volume	L^3
V		Ship or model velocity (free stream)	L/T
$V_R(x,\theta)$	VR	Radial component of fluid velocity at a given point	L/T
$\bar{V}_R(x)$		Circumferential average radial velocity component	L/T

*M = mass; L = length; T = time.

Conventional Symbol	Symbol Used on Computer Plots	Definition	Units
$V_R(x,\theta)/V$	VR/V	Radial velocity ratio	-
$\bar{V}_R(x)/V$	VRBAR	Average radial velocity ratio	-
$V_T(x,\theta)$	VT	Tangential component of the fluid velocity at a given point	L/T
$\bar{V}_T(x)$		Circumferential average tangential velocity component	L/T
$V_T(x,\theta)/V$	VT/V	Tangential velocity ratio	-
$\bar{V}_T(x)/V$	VTBAR	Average tangential velocity ratio	-
$(\tilde{V}_T(x)/V)_N$	AMPLITUDE	Amplitude (B_N for single-screw symmetric; C_N otherwise) of N^{th} harmonic of tangential velocity component ratio	-
$V_X(x,\theta)$	VX	Longitudinal component of fluid velocity at a given point (parallel to propeller axis)	L/T
$\bar{V}_X(x)$		Circumferential average velocity component	L/D
$V_X(x,\theta)/V$	VX/V	Axial velocity ratio	-
$\bar{V}_X(x)/V$	VXBAR	Average axial velocity ratio	-
$(\tilde{V}_X(x)/V)_N$	AMPLITUDE	Amplitude (A_N for single-screw symmetric; C_N otherwise) of N^{th} harmonic of longitudinal velocity component ratio	-
$V_{X_c}(x,\theta)$		$=V_X(x,\theta)-V_T(x,\theta)\tan\phi(x,\theta)$ longitudinal velocity component corrected for tangential velocity	L/T
Z		Number of propeller blades	-

Conventional Symbol	Symbol Used on Computer Plots	Definition	Units
ϕ_N	PHASE ANGLE	Phase angle of the N^{th} harmonic	deg
$1-w_X(r/R)$	1-WX	Volumetric mean velocity ratio corrected for tangential velocity	-

$$1-w_X = \frac{2\int_{r_{hub}/R}^{r/R} (\bar{V}_{X_c}(x)/V)x\,dx}{(r/R)^2-(r_{hub}/R)^2}$$

where $\bar{V}_{X_c}(x)/V =$

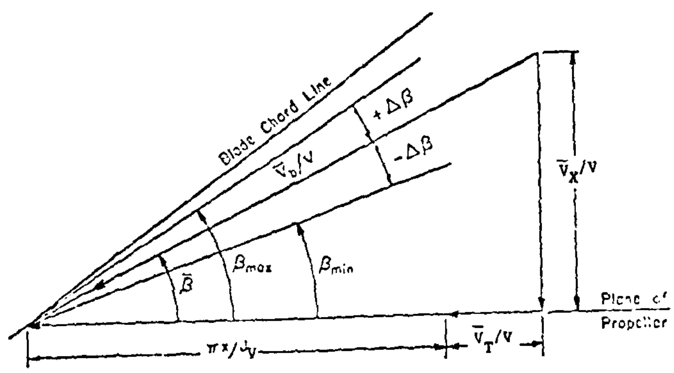
$$\int_o^{2\pi} \left(\frac{V_{X_c}(x,\theta)}{2\pi V} \right) d\theta$$

Conventional Symbol	Symbol Used on Computer Plots	Definition	Units
$1-w_{VX}(x)$	1-WVX	Volumetric mean velocity ratio without tangential velocity correction	-

$$1-w_{VX} = \frac{2\int_{r_{hub}/R}^{r/R} (\bar{V}(x)/V)x\,dx}{(r/R)^2 - (r_{hub}/R)^2}$$

Conventional Symbol	Symbol Used on Computer Plots	Definition	Units
$\beta(x,\theta)$		Advance angle for a given point in flow	deg
$\bar{\beta}(x)$	BBAR	Circumferential average advance angle	deg
$+\Delta\beta$	BPOS	Variation of maximum advance angle from the mean value (see sketch)	deg
$-\Delta\beta$	BNEG	Variation of the minimum advance angle from the mean value (see sketch)	deg

Conventional Symbol	Symbol Used on Computer Plots	Definition	Units
θ	ANGLE	Position angle of point in wake field, measured positive counter-clockwise from 12 o'clock, looking forward	deg



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ABSTRACT

Wake survey measurements of the nominal wake behind the AO-177 hull have been obtained from model experiments and are presented for cases involving trim variations and a slight change in displacement. Extensive tables and plots of the basic wake data display the three velocity component distributions, summaries of useful averaged wake quantities, and distributions of wake harmonics. Radial distributions of a wake steepness parameter are compared for the various trim conditions, and it appears that any difficulties produced by the ship wake are not introduced by the expected changes in trim.

ADMINISTRATIVE INFORMATION

This work was funded under Naval Sea Systems Command (NAVSEA) Work Request Number OH738, Ship Performance Department Work Unit Number 1532-100.

INTRODUCTION

The AO-177 Class Naval Auxiliary Oiler is a single-screw, finely-shaped oil tanker equipped with a seven-bladed, 45-degree skewed propeller operating behind a conventional clearwater stern arrangement. Some of its principal particulars are given below.

Particulars of the AO-177

	U.S. Customary	S.I.
Waterline Length, L_{WL}	560.5 ft	170.8 m
Beam	88 ft	26.8 m
Mean Draft (Design)	32.5 ft	9.9 m
Mean Draft (Trial)	31.5 ft	9.6 m
Displacement (Design)	27,380 Tons	27,820 tonnes
Displacement (Trial)	26,390 Tons	26,810 tonnes
Propeller Diameter, D	21 ft	6.4 m
Vertical Tip Clearance, a_z	6.12 ft	1.865 m
Horizontal Tip Clearance, a_{x_t}	11.4 ft	3.48 m
Full Power Speed, V	21.5 knots	

Particulars of the AO-177 (Continued)

Form Coefficients Based on L_{WL}:

$$C_B = 0.605$$

$$C_P = 0.62$$

$$C_X = 0.975$$

$$\forall / L_{WL}^3 = 5.24 \times 10^{-3}$$

On Builders Trials conducted in July 1980 with the first of the Class AO-177, there were experienced serious levels of airborne noise, traces of propeller blade cavitation erosion with bent trailing edge, and some unpleasant localized structural vibration levels. It is likely that all these problems can be traced in one way or another to the characteristics of fluctuating cavities that appear near the propeller blade tips as each blade passes through the large wake shadow behind the hull centered about the 12 o'clock position of the propeller disc. The details of this wake are important to understanding the sources of any propeller-excited difficulties.

As best as can be determined, the *initial trial* was run in a bow-down trim condition that differed somewhat from the design condition. It could not be estimated with assurance just what the effects of trim were on the wake distribution of this ship, so the experiments described in this report were performed to establish what changes were introduced by operation at the estimated trim of the trial, and also to establish any trends produced by a more extreme bow down condition.

The estimated trial displacement of 26,390 tons (26,810 tonnes) is 96.4 percent of the original full load design value. Relative changes of static trim, away from the design condition, can be defined in terms of an angle based on the length between perpendiculars and the difference in trim.

	Trim Condition	Change in Trim Angle
Design	1.5 ft(0.457 m) x Stern	--
Trial (Estimated)	1.0 ft(0.305 m) x Bow	0.26 deg
Extreme Trim Case	3.5 ft(1.067 m) x Bow	0.52 deg

PROCEDURE

Wake survey experiments were conducted in the deep water basin of Carriage 2 using David W. Taylor Naval Ship Research and Development Center (DTNSRDC) Model 5326 which represents the AO-177 hull with a linear scale ratio of λ = 25.682. The model was run with the bilge keels attached, but with the rudder removed to accommodate the wake survey probe.

The three velocity components of the wake velocity were obtained with DTNSRDC pitot tube rake Number 8 connected to a bank of differential pressure transducers. This rake consists of five, 5-hole spherically-headed pitot tubes mounted on a foil shaped housing. The tips of the pitot tubes were located at a nominal propeller plane taken as 4.62 ft (1.408 m) aft of Station 19.5 full-scale, corresponding to the location of the plane of the original wake survey reported by Remmers and Hendrican.[1*] As indicated in Figure 1, the experimental wake plane is 1.12 ft (0.3414 m) aft full-scale of the propeller reference plane, and happens to pass through the leading edge of the propeller swept outline at a radius of about 0.75R. Some details of the propeller geometry for DTNSRDC Propeller Number 4677 are given by Hendrican and Remmers[2] and Valentine and Chase.[3]

The radial locations of the pitot tubes are of course fixed on the model apparatus, and are expressed nondimensionally as radius ratios r/R, given for full-scale propeller diameters of 21 ft (6.4 m) and 23 ft (7.01 m) in the following table.

Radius Ratios, r/R

	D=21 ft (6.4 m)	D=23 ft (7.01 m)
Tube 1	0.359	0.328
Tube 2	0.556	0.508
Tube 3	0.774	0.707
Tube 4	1.017	0.929
Tube 5	1.178	1.076

The radius ratios for the 23 ft (7.01 m) diameter are useful for certain comparisons that overlap with the original AO wake survey results of Reference 1.

*References are listed on Page 9.

However, the final design propeller installed on the ship has a diameter of 21 ft (6.4 m), and all the new wake data have been analyzed on that basis. The radial positions of the pitot tube locations and relative position of the 21 ft (6.4 m) propeller disc with respect to the afterbody hull sections are shown in Figure 2.

Certain other definitions and conventions are also presented in Figure 2. When viewed looking forward, the angle θ is measured positive counterclockwise, with zero at 12 o'clock. The tangential and radial velocity components, V_T and V_R respectively, are taken as shown in Figure 2 to agree with the convention described by Hadler and Cheng.[4]

The shape of the pitot tube rake is such that the trim of the model could be altered by forces generated on the rake in various angular positions. In order to maintain the natural trim the same throughout each survey, the model was first towed free to trim with the rake in the zero degree position for each experimental condition at a speed corresponding to the ship speed of 20 knots. The model was then locked in trim for that particular experiment.

Five wake survey experiments reported on here correspond to a ship speed of 20 knots and the following ship conditions of displacmeent and trim.

Date	Experiment No.	Displacement (Tons)	(tonnes)	Trim (ft)	(m)
May 1974	21	27,380	27,820	1.5	0.457 x Stern
Aug 1980	1	27,380	27,820	1.5	0.457 x Stern
Aug 1980	2	26,390	26,810	1.5	0.457 x Stern
Aug 1980	3	26,390	26,810	1.0	0.305 x Bow
Aug 1980	4	26,390	26,810	3.5	1.067 x Bow

The new data presented in this report are for the latter four cases (Experiments 1 through 4).

The model basin water temperature was constant throughout the test period at 74 deg Fahrenheit (23 deg Celsius).

RESULTS AND DISCUSSION

Results of the individual wake experiments are presented in both graphical and tabular form in Appendices A through D for the results of Experiments 1 through 4, respectively. In each appendix, the plotted data for the three velocity component ratios are given in the first five figures. Two additional figures in each appendix show the radial distributions of the mean velocity component ratios and the

advance angles. Five of the tables of each appendix present summary information on the several averaged velocity component ratios, advance angles, and the results of harmonic analysis for the longitudinal and tangential velocity components. The final table in each appendix presents the measured data for the three velocity component ratios at the experimental radius ratios. All the interpolated results in the appendices have been based on propeller diameter D=21 ft (6.4 m).

To confirm and also to establish a basis on which to correlate the wake survey data, Experiment 1 (August 1980) of the present series was performed with the same condition as Experiment 21 (May 1974) reported in Reference 1. A comparison between some results of these two experiments at a condition representing a full-scale displacement of 27,380 Tons (27,820 tonnes) and 1.5 ft (0.457 m) trim by the stern is given in Table 1 on the basis of propeller diameter D=23 ft (7.01 m). The repeatability of magnitudes of the various averaged wake quantities in the outer half of the propeller disc ranges from 1 to 3 percent for $\bar{V}_X/V$ and 0.2 to 2 percent for $1-w_X$. At the innermost measurement radius, the repeatability degrades to plus or minus 6 to 8 percent for those same quantities.

The effects of trim may be displayed in several ways. Table 2 summarizes the averaged velocity ratios and other derived wake characteristics for the results of Experiments 2, 3, and 4 pertaining to a full-scale displacement of 26,390 Tons (26,810 tonnes). Plotted data for the detailed trim comparison of the three velocity component ratios versus the position angle θ are given in Figures 3 through 7. Figure 8 is a composite graph of the radial distributions of the several averaged velocity component ratios. Figure 9 shows comparisons of the radial distributions of the advance angles.

In general, it appears that the influence of trim-by-the-bow is to deepen the wake shadow very slightly, noticeable only at the inner radii. That is, the V_X/V ratios near the 12 o'clock position in the wake field are decreased systematically as the trim is changed from 1.5 ft (0.457 m) by the stern to 3.5 ft (1.067 m) by the bow. At the middle and outer radii (r/R = 0.774 and outward) the velocity patterns for V_X/V at the different trims become indistinguishable. These trends are reflected in the slight decreases in the circumferential average velocity ratio $\bar{V}_X/V$ and the volumetric mean velocity ratio $1-w_X$ with increasing trim-by-the-bow. The effect on the magnitudes of both $\bar{V}_X/V$ and $1-w_X$ ranges from about 7 to 8 percent decrease at the innermost radius to about 2 percent decrease at the outermost radii.

In Figure 9, the effect of trim on mean angle of advance $\overline{\beta}$ is negligible even at the inner radius ratios. The variations of minimum and maximum advance angles from the mean, $-\Delta\beta$ and $+\Delta\beta$, indicate that increasing trim-by-the-bow tends to exaggerate slightly the deviations of advance angle on the negative side. Qualitatively, this indicates that increasing bow down trim produces slight increases in the mean foil section angles of attack, so that suction side cavitation would be slightly exaggerated as well. Quantitatively, the effect is very small, and is confined to the inner radii of the propeller disc.

It is interesting to try to discern any effect of trim on the wake harmonics. Figures 10 and 11 contain a series of composite plots for the harmonics N=1 through 8, showing the radial distributions of harmonic amplitudes for the longitudinal velocity component V_X/V. Figures 12 and 13 contain the same series of comparisons for the tangential velocity component V_T/V. This presentation is useful for displaying the harmonic amplitude as well as the location of changes of phase angle (where the amplitude curve crosses zero). From these graphs, the measurable influence of trim on the harmonic amplitudes is only slight, and confined to the lower harmonic orders.

For the case of the longitudinal velocity component harmonics (Figures 10 and 11), there is a slight increase in the magnitude of the harmonic amplitude with increasing bow-down trim, at the inner radii ($r/R < 0.6$) for the orders N=1 and 2. This is reversed for N=3, and appears mixed for the higher orders. This is consistent with the slight deepening of the V_X/V velocity defect at the inner radii that was noted previously.

For the case of the tangential velocity component harmonics (Figures 12 and 13), the effect of increasing bow-down trim is to reduce the harmonic amplitude at the inner radii for N=1. The higher harmonic orders show no particular effect of trim.

In general terms, the wake of the AO-177 has a definite spike-like character, with a deep velocity defect and rather steep velocity gradients centered about the 12 o'clock position. These are prominent features evident in Figure 14 which is an iso-wake contour plot corresponding to the trial condition of 26,390 Tons (26,810 tonnes) displacement and 1 ft (0.305 m) trim by the bow. One measure of the relative steepness of such a wake has been suggested by Odabasi and Fitzsimmons,[5] who have defined a parameter describing the local wake gradient per unit axial velocity at a given radius.

$$G_W = \frac{1}{r/R} \left| \frac{dw/d\theta}{1-w} \right|$$

where the local circumferential wake slope is $dw/d\theta$, θ is in radians, and w is the local wake.

It has been proposed in Reference 5, as part of a complete wake criterion for avoiding problems with cavitation-induced pressure fluctuations, that the wake gradient parameter should satisfy

$$G_W < 1.0$$

inside the angular interval θ_B ($\frac{1}{2}\theta_B$ to either side of the 12 o'clock position), and for radii ranging from 0.7R to 1.15R. The angular interval θ_B in degrees depends on the number of propeller blades

$$\theta_B = \frac{360}{Z} + 10$$

so for the seven-bladed AO propeller, θ_B = 61.4 degrees. This criterion is supposed to be based in part on wake data from model experiments of ships with known propeller-excited vibration problems. The complete wake assessment scheme of Reference 5 has become known as the British Ship Research Association (BSRA) wake quality criterion, and although it has been widely quoted, there is as yet relatively little published evidence on how well it works. Only the wake gradient part of it is conisdered here, and is used only to indicate the <u>relative</u> effects of trim.

Figure 15 is a composite plot of the radial distribution of the wake gradient parameter G_W for the AO-177, showing the effects of trim changes compared with the original design case of displacement and trim. The G_W values are shown along the ray $\theta = 30^o$ which is near the edge of the recommended angular interval $\frac{1}{2}\theta_B$, and passes through the characteristic wake slope feature of the prominent hull wake shadow. On the basis of the gradient parameter, it appears that the wake of this ship is quite steep. The G_W exceeds 1.0 everwhere in the interval $0.7R \leq r \leq 1.15$ R. It is fair to state that this constitutes a single indicator of a possibly troublesome wake, but without firmer connection between wake steepness and fluctuating propeller-induced pressures and resulting hull vibration or airborne

noise problems, a general conclusion is premature. What is useful to the present discussion is to note that trim seems to exert a relatively minor effect on this steepness tendency in the crucial outer radius region. It appears that bow-down trim variation in the range considered should not introduce any substantially worse wake characteristics than exist already with the wake produced in the original trim condition. It should be noted that at the time of the original AO-177 wake experiments, wake quality assessment schemes were not available for making preliminary judgments on the possibility of problems with the interaction of steep wakes and propeller-induced fluctuating pressures.

CONCLUSIONS

1. Extensive wakedata are made available for future investigations of the AO-177 propeller-wake interaction problems.

2. There are noticeable, consistent, but small changes in the velocity patterns and harmonic amplitudes of the wake of the AO due to trim-by-the-bow. The effects are discernible mainly at the inner radii (typically $r/R < 0.6$) and are confined to the region centered about the 12 o'clock position in the wake. The changes due to the maximum trim excursion of 0.52 deg are only slightly larger than the typical repeatability bounds for a wake survey. The effect of a trim change of 0.26 deg appears to be within the error bounds inherent in a wake survey experiment.

3. Radial distributions of the wake gradient parameter $G_W > 1.0$ for this wake shows that difficulties from unsteady cavitation pressure pulses may be expected. The effect on G_W of the trim change of 0.26 deg is small, and would not be expected to produce new or different problems with the wake.

ACKNOWLEDGMENTS

The authors are grateful to Ms. Rae Hurwitz and Mr. Stewart Jessup for performing the analyses of the wake survey data. The assistance of Mr. Mark Vranicar in preparing the graphs is also appreciated.

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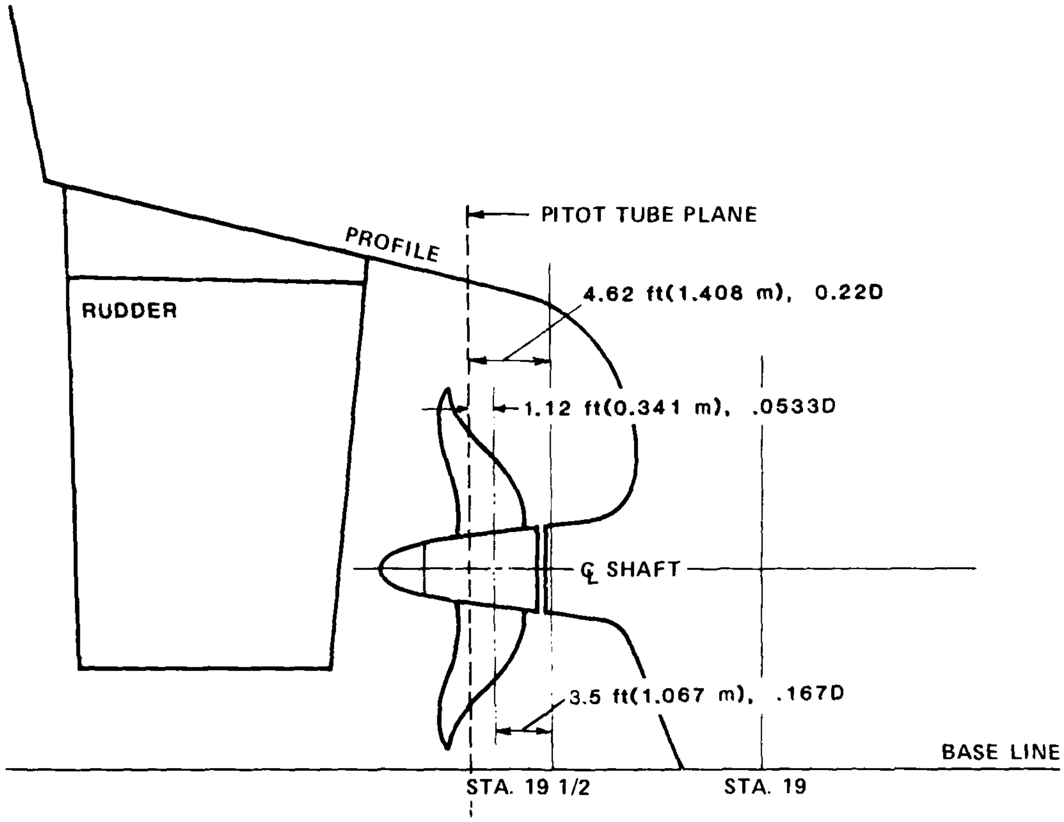


Figure 1 - AO 177 Wake Rake Pitot Tube Location in Relation to the 21-Foot (6.4 m) Design Propeller

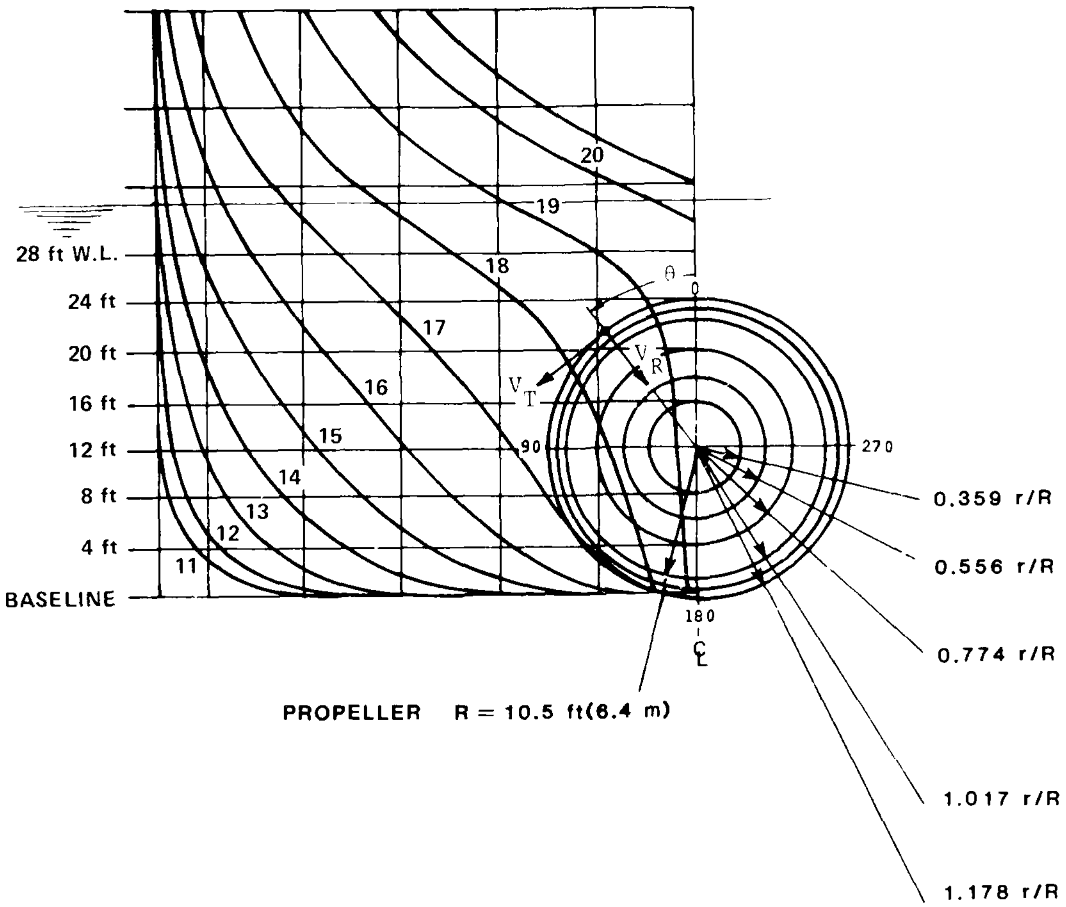
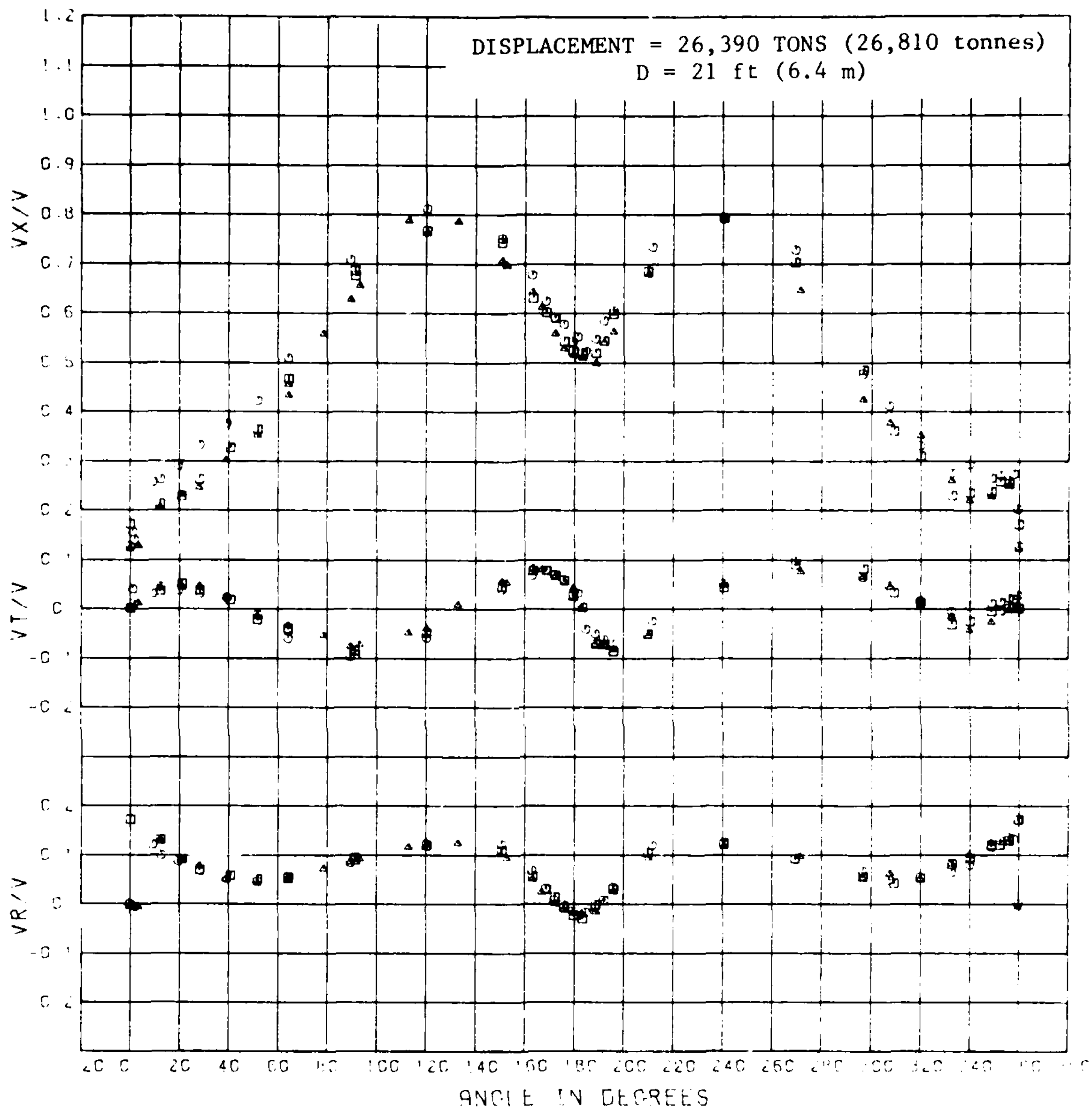
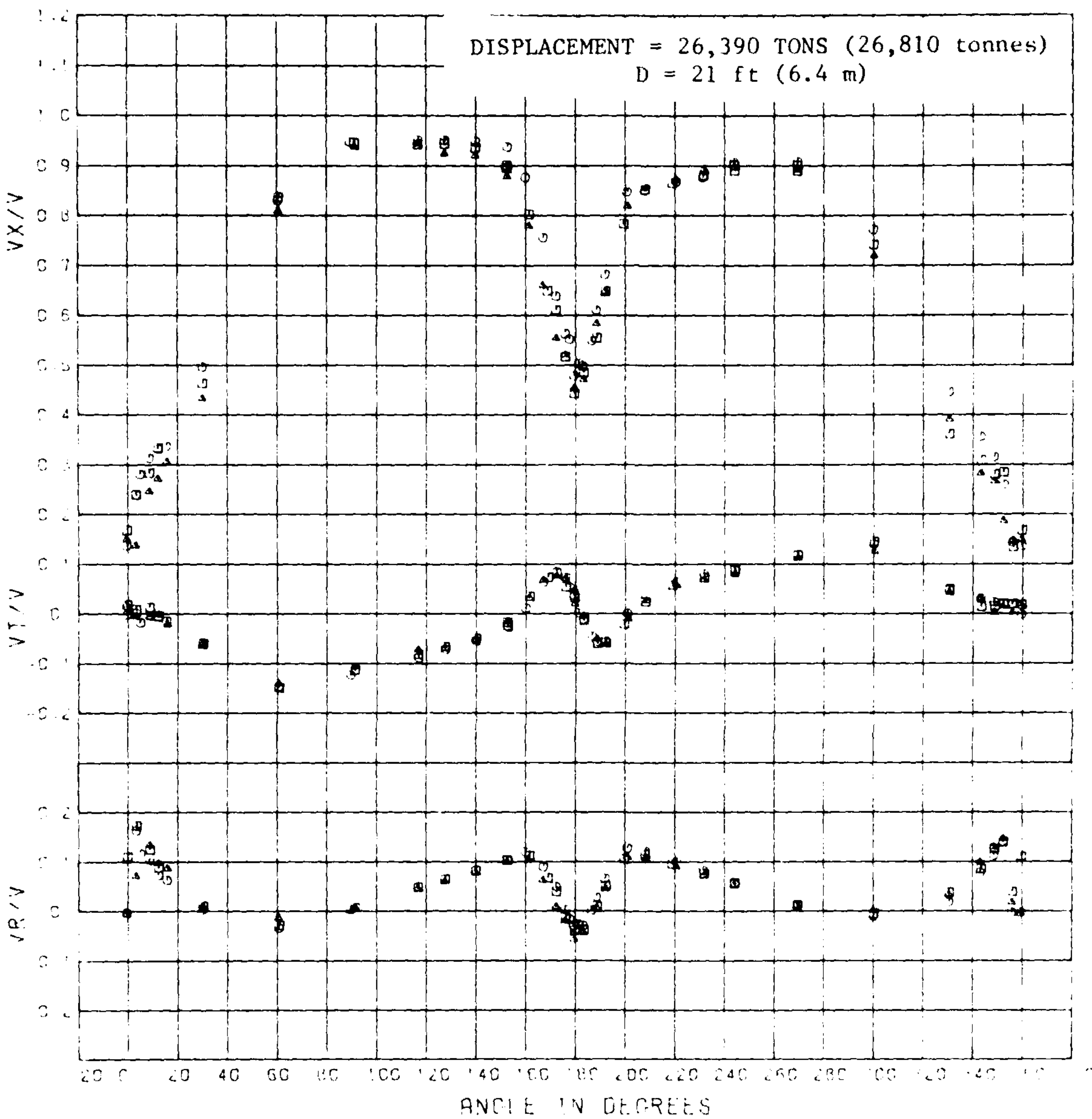


Figure 2 - AO 177 STERN BODY PLAN WITH TEST RADII



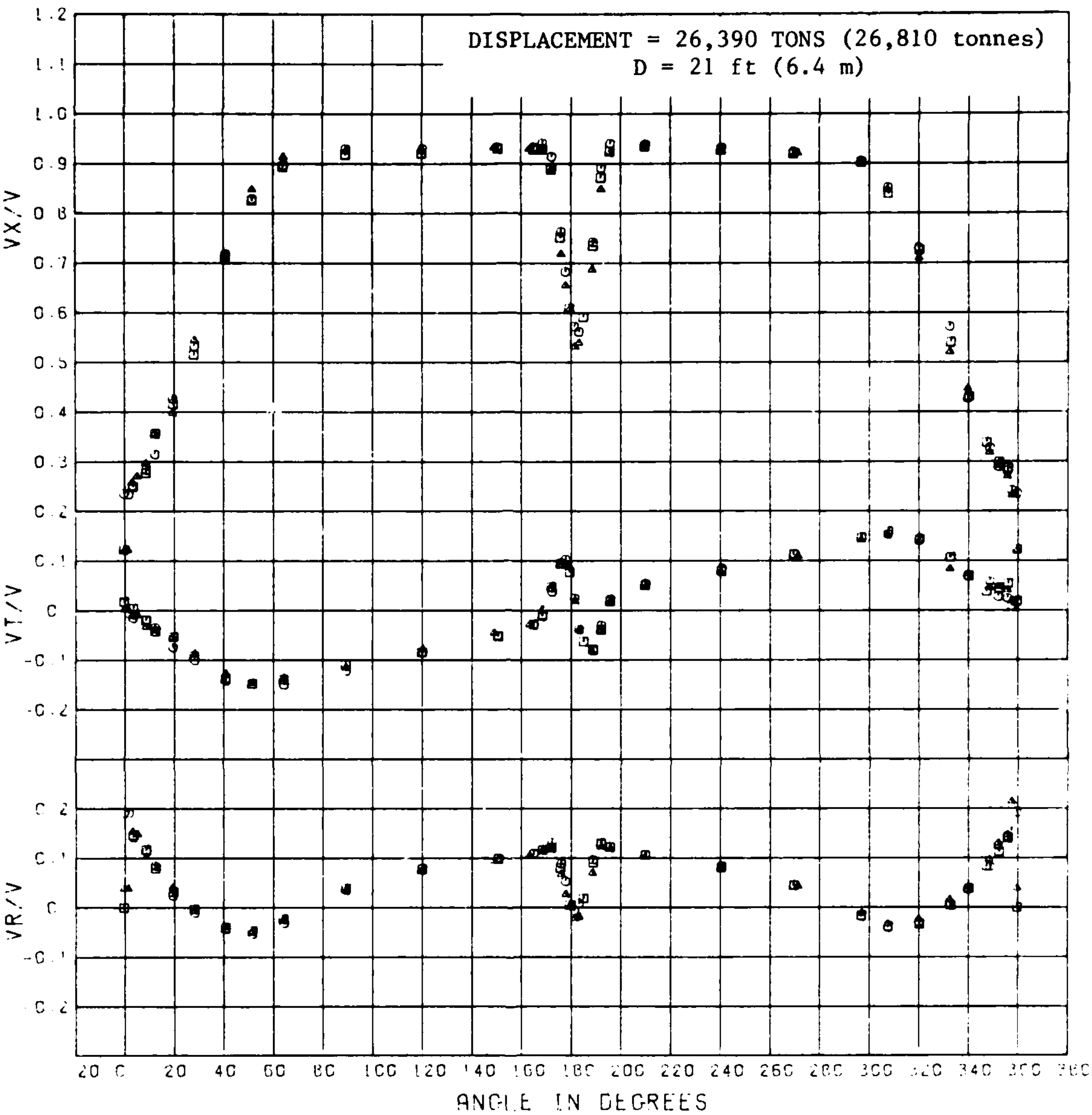
O EXPERIMENT 2 TRIMMED 1.5 ft (0.457 m) x STERN
□ EXPERIMENT 3 TRIMMED 1.0 ft (0.305 m) x BOW
△ EXPERIMENT 4 TRIMMED 3.5 ft (1.067 m) x BOW

Figure 3 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.359 COMPOSITE OF EXPERIMENTS 2, 3, AND 4



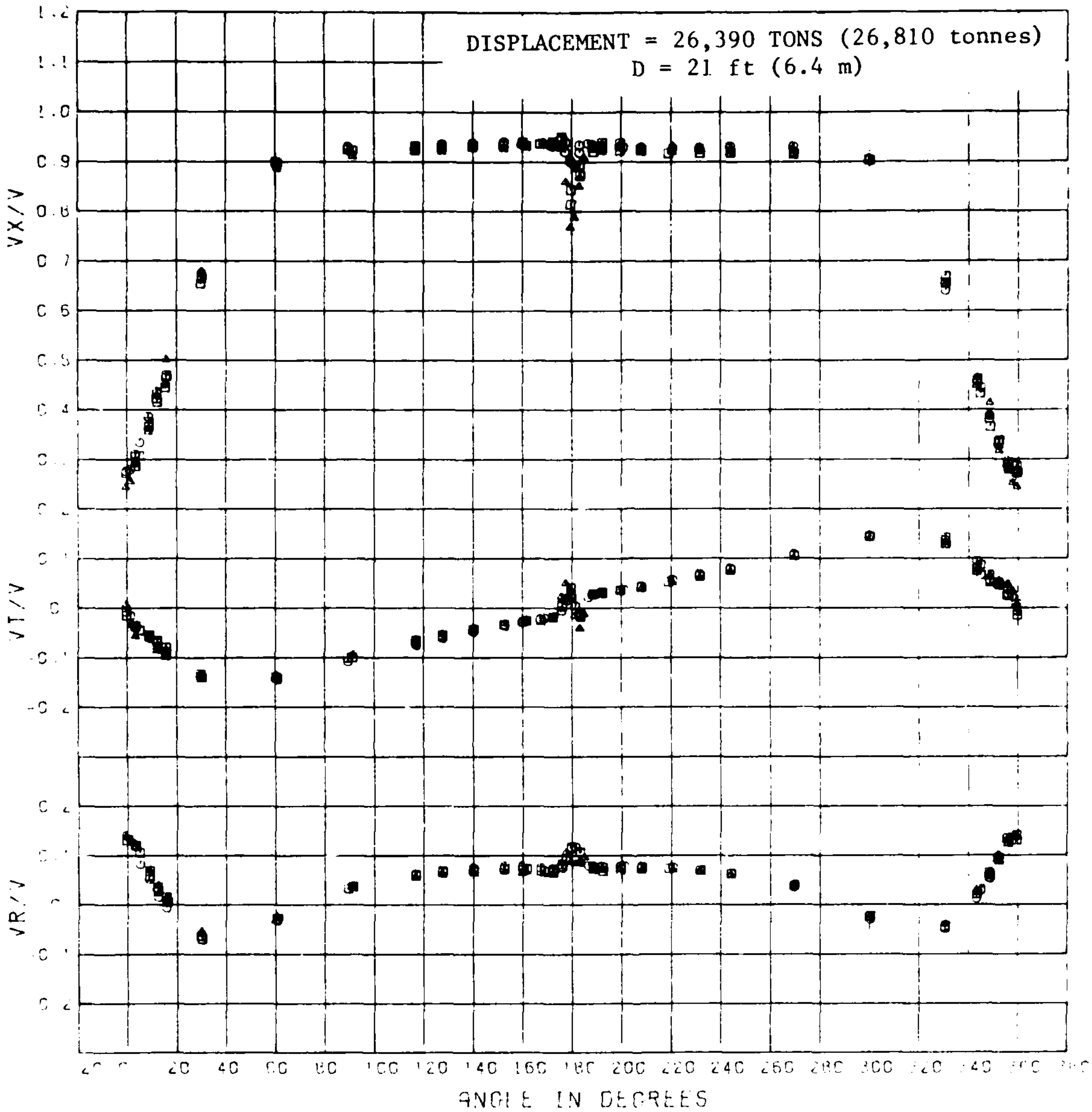
O EXPERIMENT 2 TRIMMED 1.5 ft (0.457 m) x STERN
□ EXPERIMENT 3 TRIMMED 1.0 ft (0.305 m) x BOW
△ EXPERIMENT 4 TRIMMED 3.5 ft (1.067 m) x BOW

Figure 4 - CIRCUMFERENTIAL DISRTIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.556 COMPOSITE OF EXPERIMENTS 2, 3, AND 4



O EXPERIMENT 2 TRIMMED 1.5 ft (0.457 m) x STERN
□ EXPERIMENT 3 TRIMMED 1.0 ft (0.305 m) x BOW
▲ EXPERIMENT 4 TRIMMED 3.5 ft (1.067 m) x BOW

Figure 5 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.774 COMPOSITE OF EXPERIMENTS 2, 3, AND 4



○ EXPERIMENT 2 TRIMMED 1.5 ft (0.457 m) x STERN
□ EXPERIMENT 3 TRIMMED 1.0 ft (0.305 m) x BOW
△ EXPERIMENT 4 TRIMMED 3.5 ft (1.067 m) x BOW

Figure 6 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 1.017 COMPOSITE OF EXPERIMENTS 2, 3, AND 4

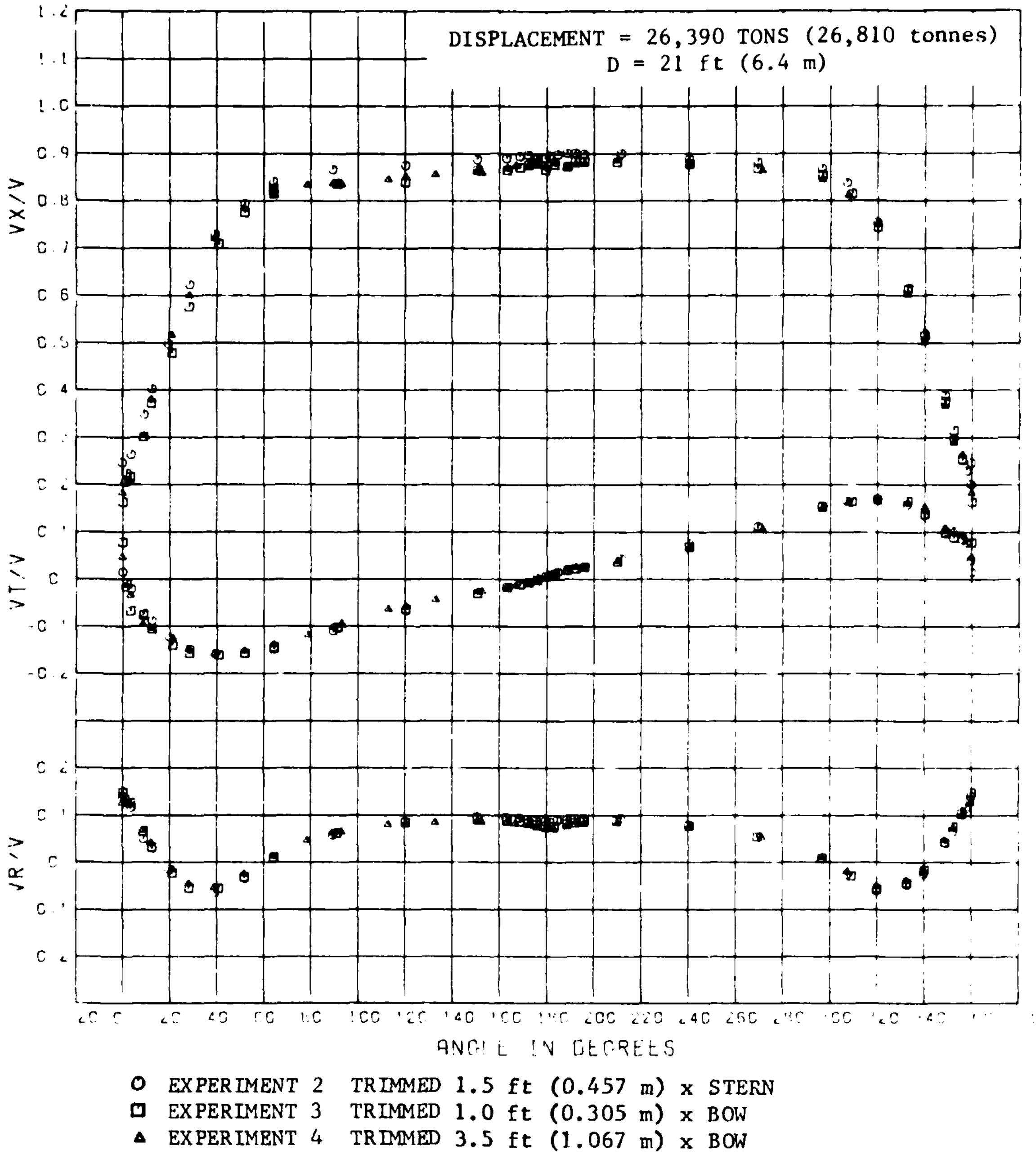


Figure 7 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 1.178 COMPOSITE OF EXPERIMENTS 2, 3, AND 4

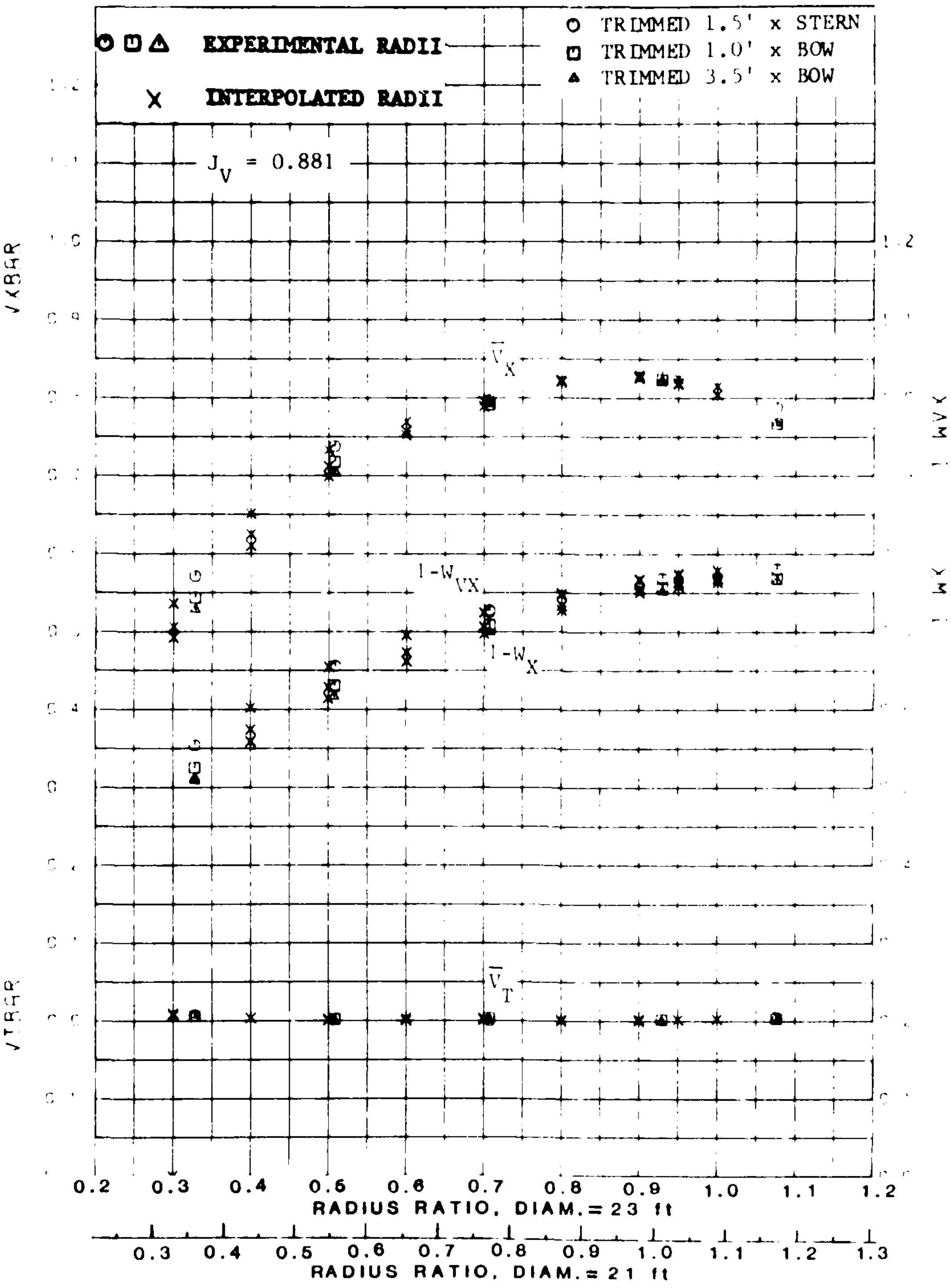


Figure 8 - RADIAL DISTRIBUTION OF THE MEAN VELOCITY COMPONENT RATIOS, COMPOSITE OF EXPERIMENTS 2, 3, AND 4 DISPLACEMENT 26,390 TONS (26,810 tonnes)

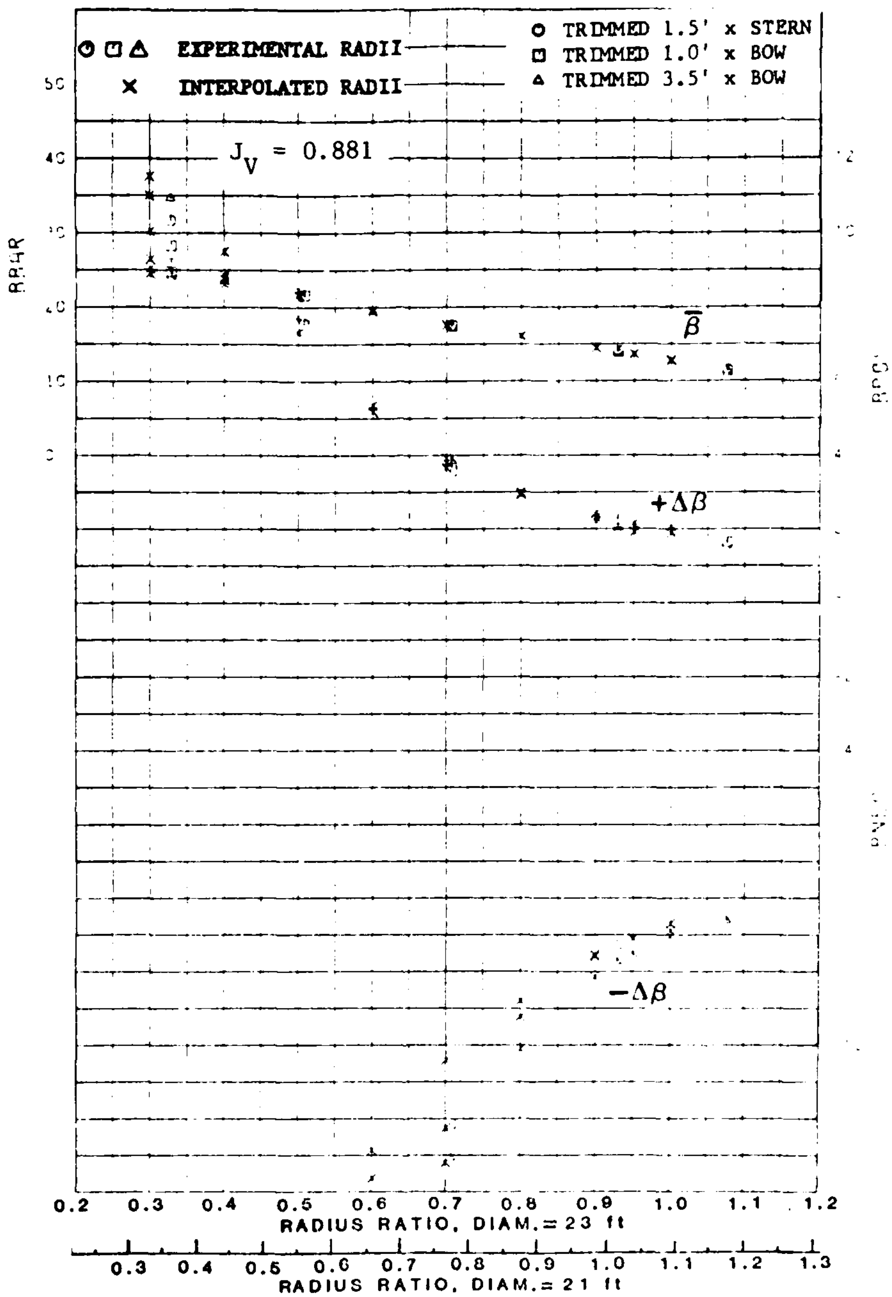


Figure 9 - RADIAL DISTRIBUTION OF THE MEAN ADVANCE ANGLE AND THE MAXIMUM VARIATIONS OF THE ADVANCE ANGLE FOR MODEL 5326
COMPOSITE OF EXPERIMENTS 2, 3, AND 4
DISPLACEMENT 26,390 TONS (26,810 tonnes)

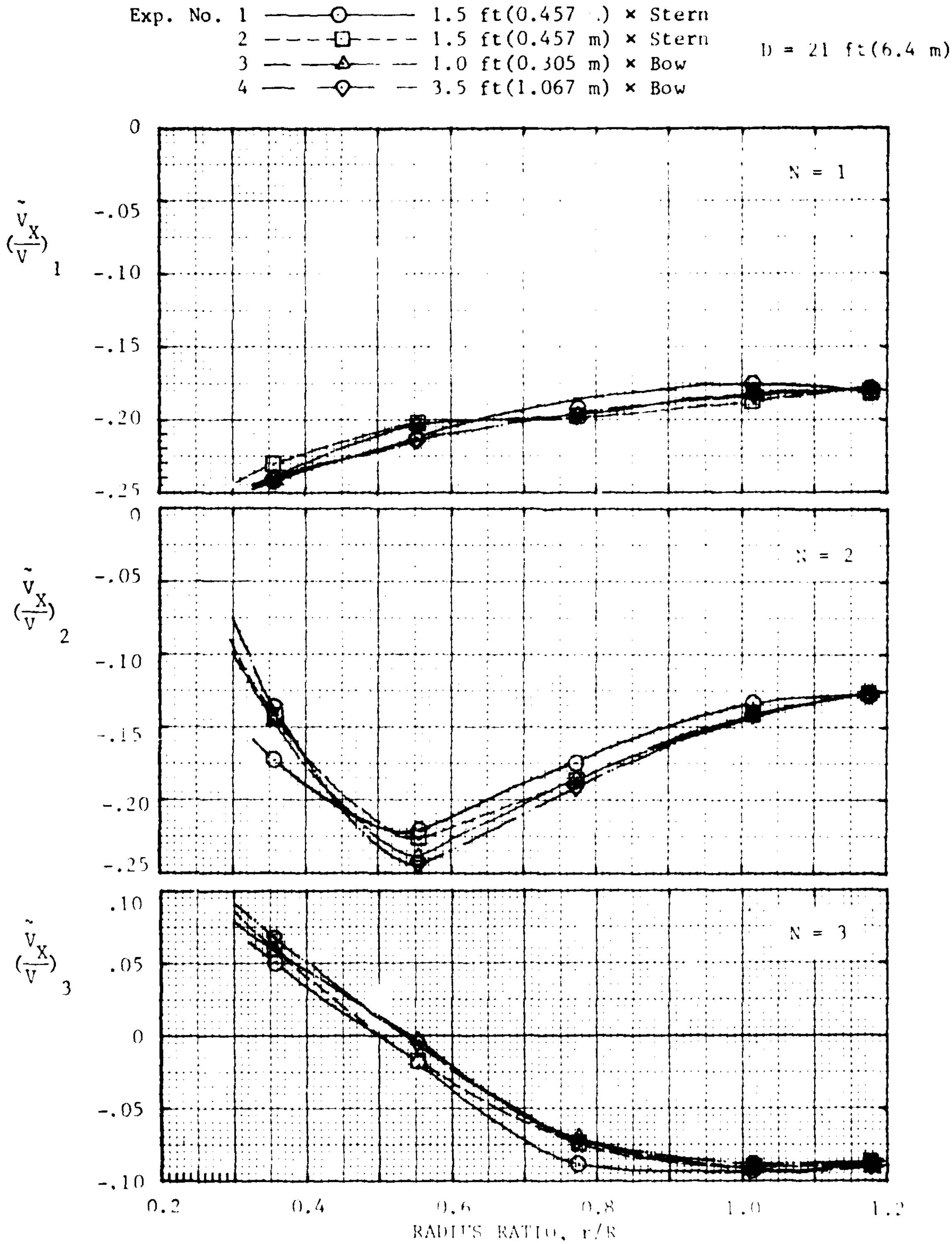


Figure 10 - RADIAL DISTRIBUTIONS OF THE HARMONIC AMPLITUDES $(\tilde{V}_X/V)_N$ OF THE LONGITUDINAL VELOCITY COMPONENT, FOR N = 1 THROUGH 3

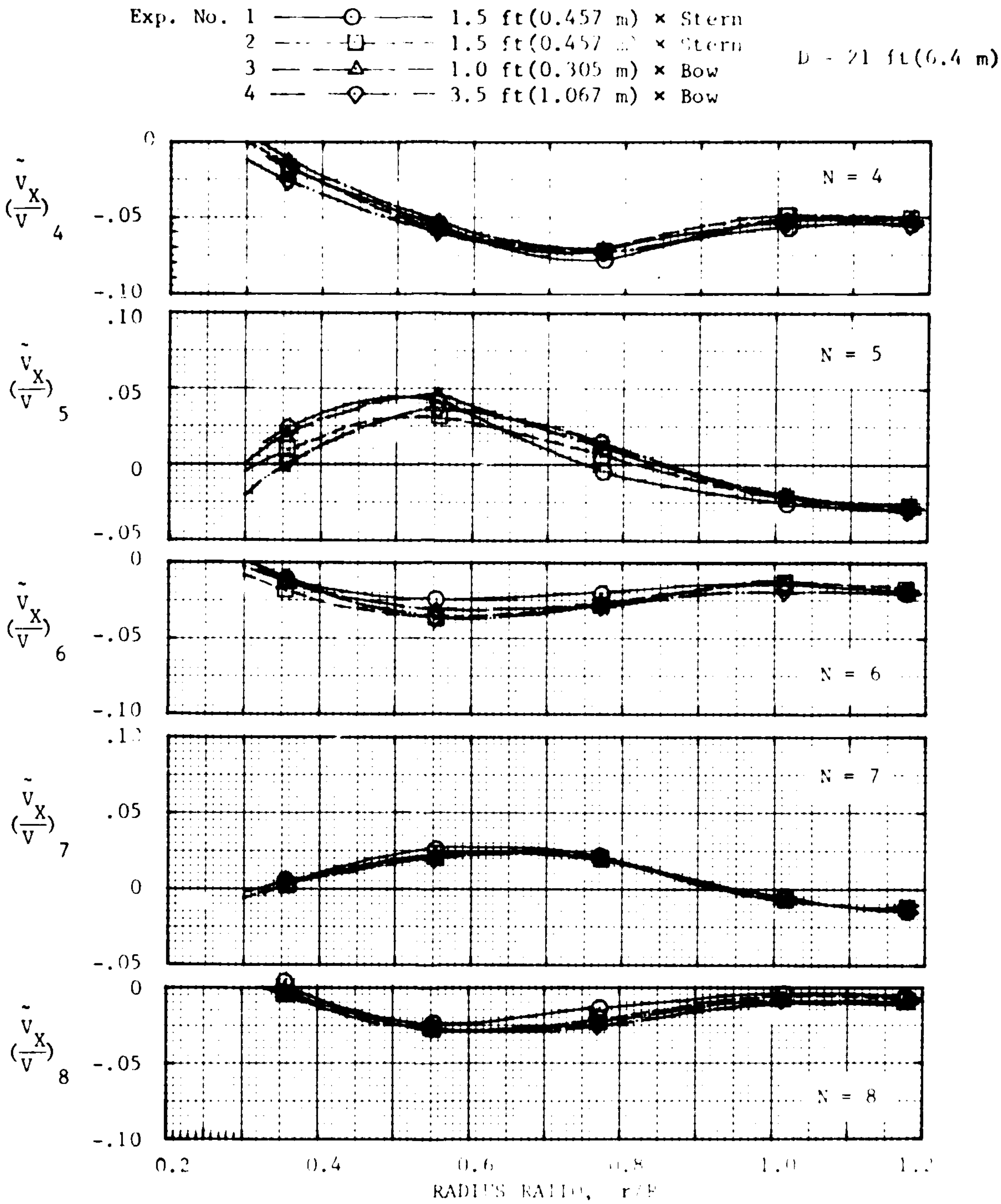


Figure 11 - RADIAL DISTRIBUTIONS OF THE HARMONIC AMPLITUDES $(\tilde{V}_X/V)_N$ OF THE LONGITUDINAL VELOCITY COMPONENT, FOR N = 4 THROUGH 8

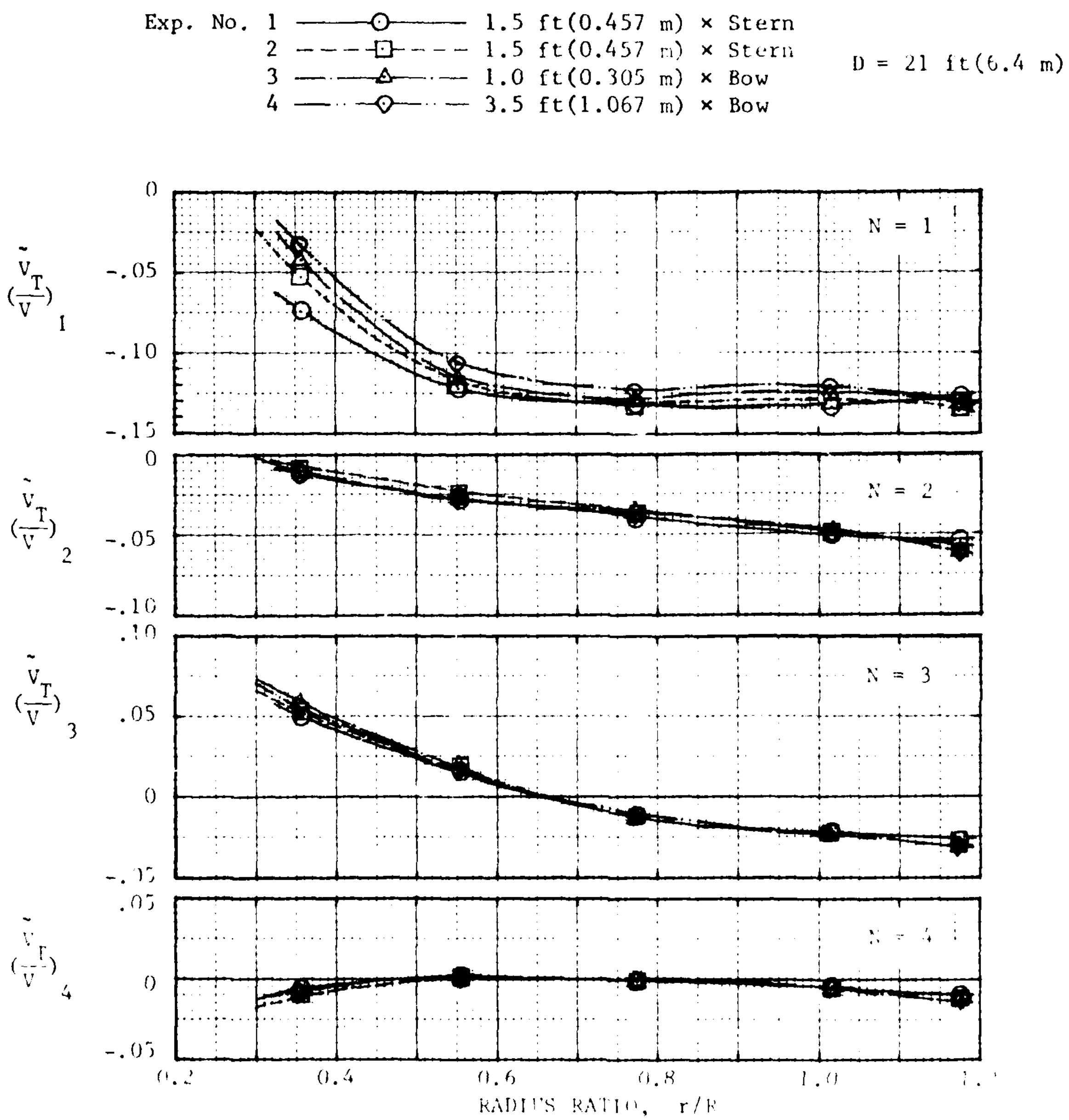


Figure 12 - RADIAL DISTRIBUTIONS OF THE HARMONIC AMPLITUDES $(\tilde{V}_T/V)_N$ OF THE TANGENTIAL VELOCITY COMPONENT, FOR N = 1 THROUGH 4

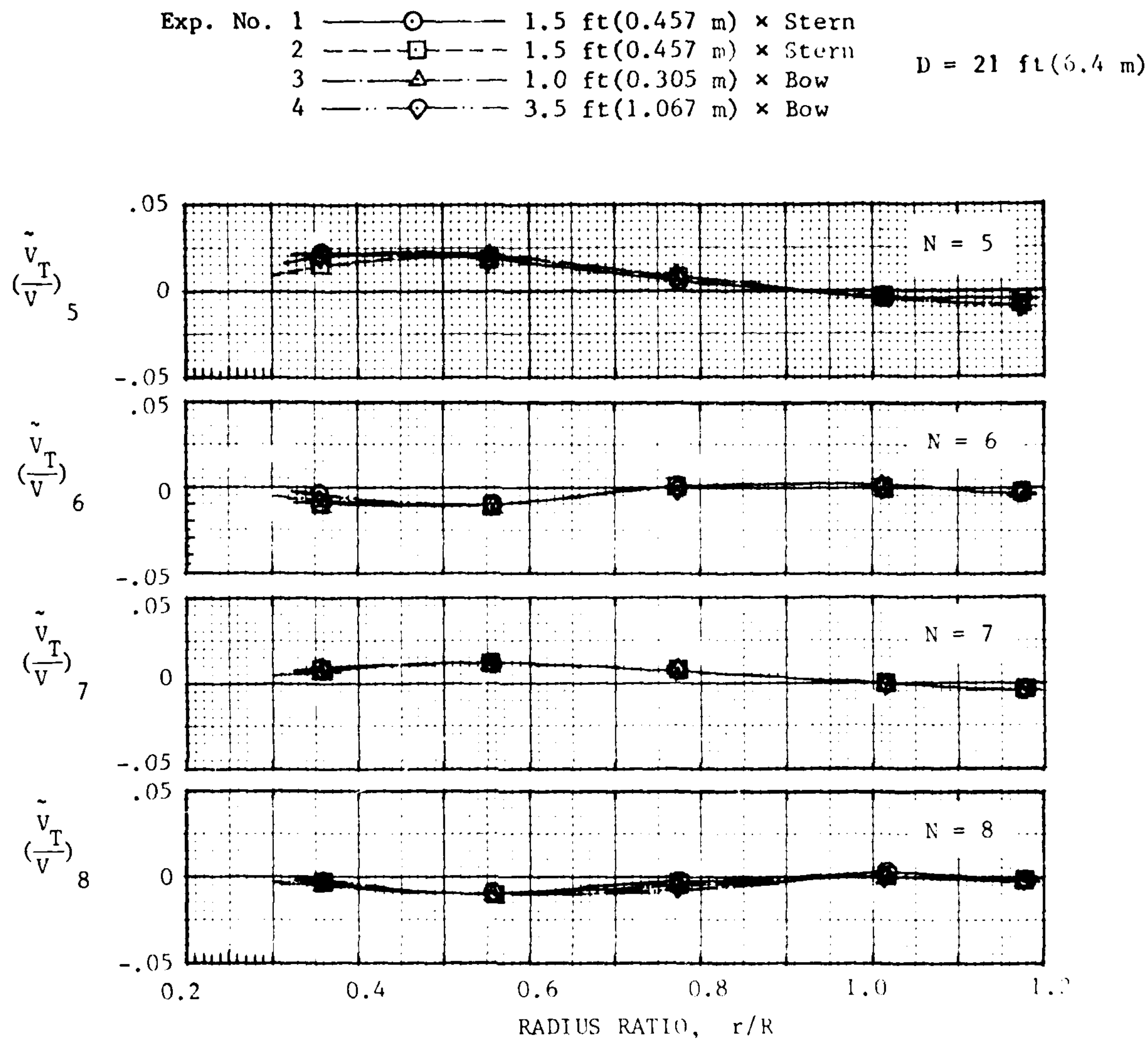


Figure 13 - RADIAL DISTRIBUTIONS OF THE HARMONIC AMPLITUDES $(\tilde{V}_T/V)_N$ OF THE TANGENTIAL VELOCITY COMPONENT, FOR N = 5 THROUGH 8

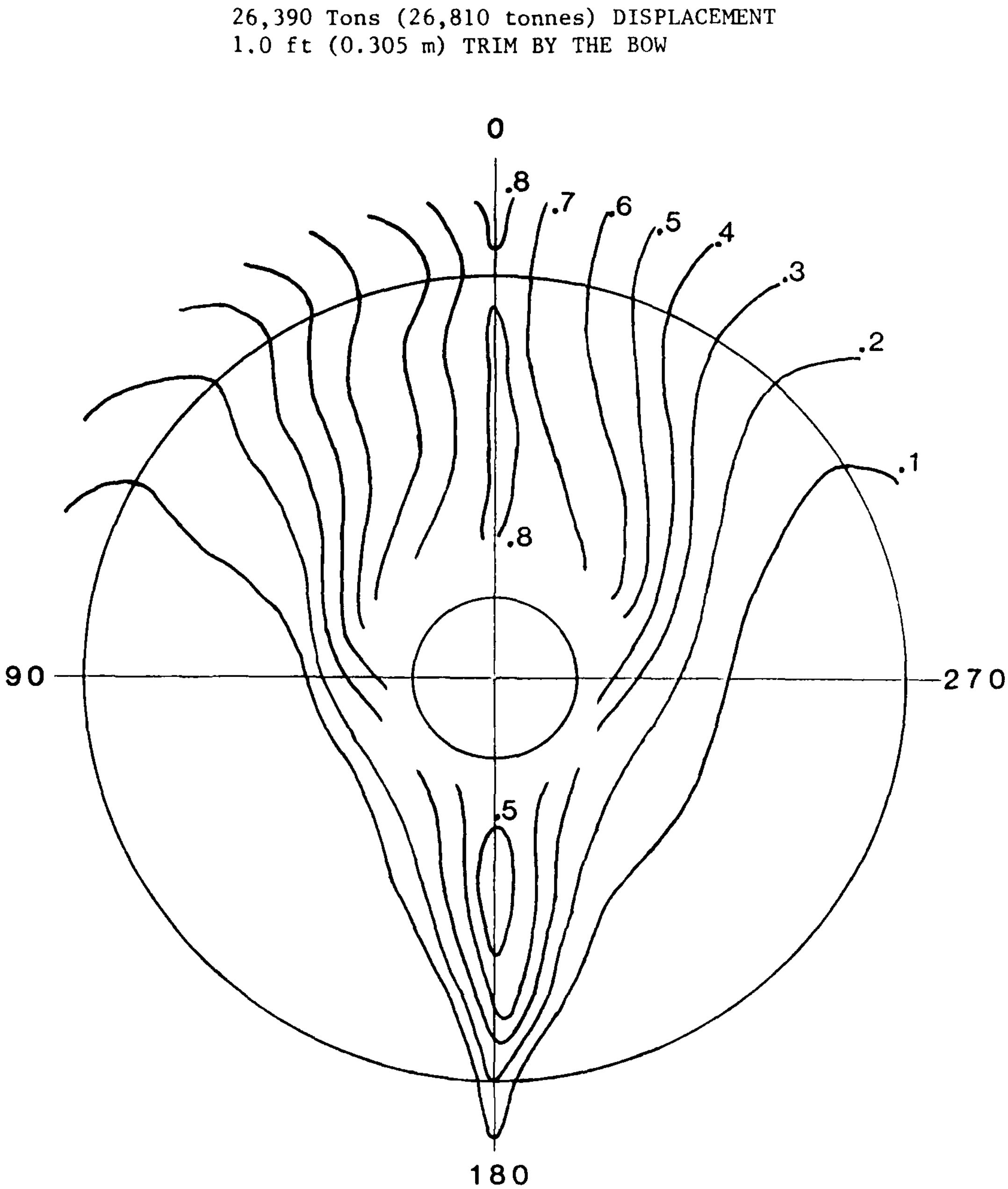


Figure 14 - CONTOUR PLOT OF THE LONGITUDINAL COMPONENT ISO-WAKE $w = (1 - V_X/V)$ FOR THE AO 177 (MODEL 5326)

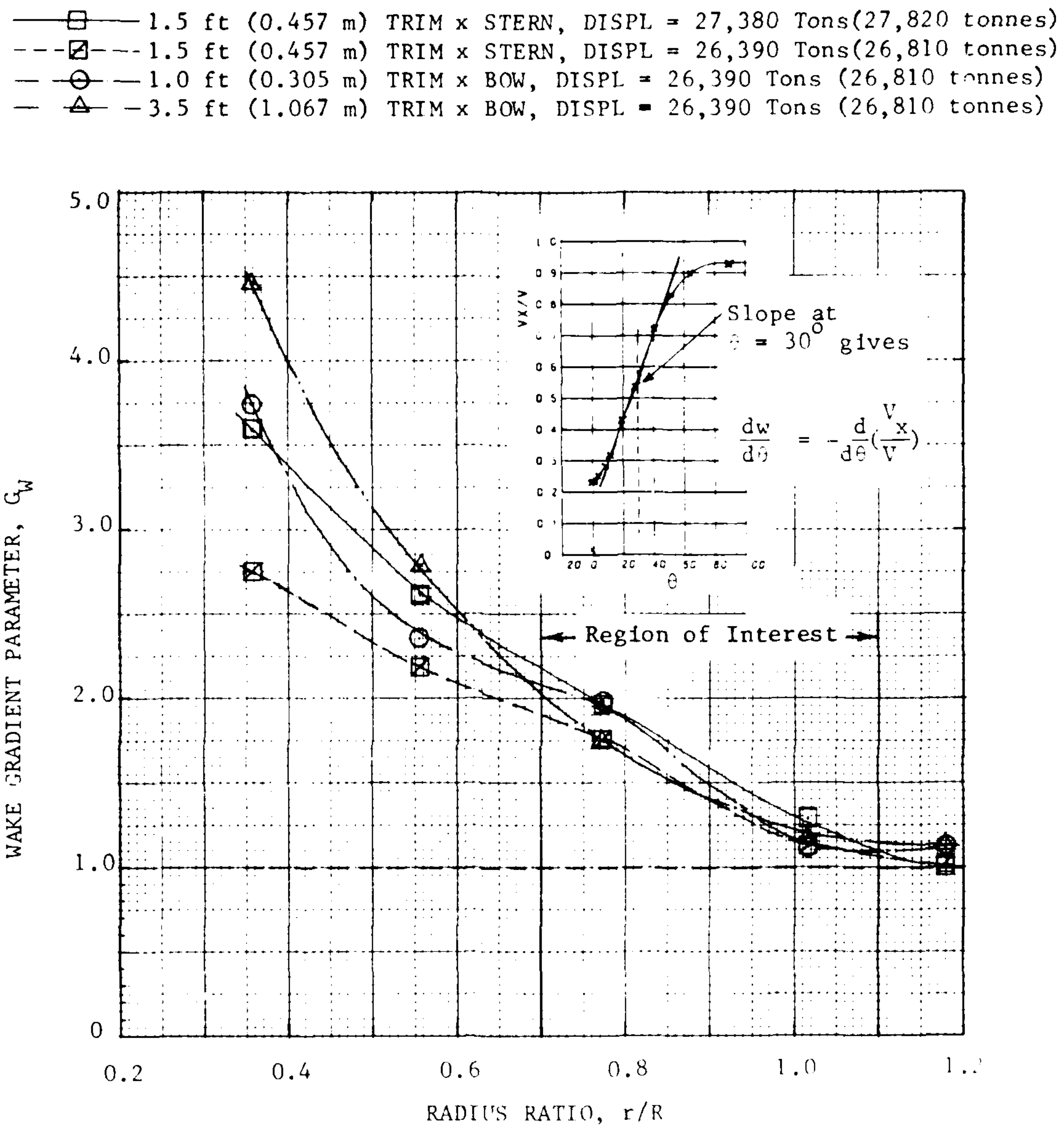


Figure 15 - RADIAL DISTRIBUTION OF THE WAKE GRADIENT PARAMETER FOR THREE TRIM CONDITIONS

(Taken along the ray θ = 30 degrees)

Table 1 COMPARISON OF THE MEAN VELOCITY COMPONENT RATIOS AND OTHER DERIVED QUANTITIES FOR EXPERIMENT 21 (MAY 1974) AND EXPERIMENT 1 (AUG. 1980)

$D = 23$ ft (7.01 m), $J_V = 0.881$

EXPERIMENT	RADIUS	VXBAR	VTBAR	VRBAR	1-WX	BBAR	BPOS	BNEG
21	.328	.615	.000	.054	.605	27.72	10.34	-16.14
1		.577	.007	.084	.558	26.12	10.61	-19.17
21	.508	.741	.000	.046	.680	22.25	6.38	-14.33
1		.754	-.001	.039	.648	22.60	7.33	-14.88
21	.707	.814	.000	.043	.741	17.38	3.46	-11.99
1		.797	.000	.049	.738	17.55	3.77	-14.68
21	.929	.817	.000	.030	.779	13.85	2.10	- 8.80
1		.839	-.002	.027	.777	14.21	2.38	- 9.30
21*	1.076	.839	.000	.041	.792	12.33	1.71	- 8.39
1		.817	.001	.044	.791	12.01	1.69	- 8.55

*EXPERIMENT 21 (MAY 1974)
An instrumentation problem with tube 5 ($r/R = 1.076$) gave erroneous data between 250° and 350°. Because of the symmetry of the hull (as verified by tubes 1 through 4) predicted values for V_X/V, V_T/V, and V_R/V, were used between 250° and 350° for $r/R = 1.076$.

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).

Table 2 - COMPARISON OF THE MEAN VELOCITY COMPONENT RATIOS AND OTHER DERIVED QUANTITIES FOR EXPERIMENTS 2,3, AND 4, DISPLACEMENT 26,390 TONS (26,810 tonnes)

$D = 21$ ft (6.4 m), $J_V = 0.881$

EXPERIMENT	TRIM (feet)	RADIUS	VXBAR	VTBAR	VRBAR	1-WX	BBAR	BPOS	BNEG
2	1.5 x stern	0.359	.571	.007	.082	.554	25.90	10.33	-18.98
3	1.0 x bow		.543	.005	.085	.525	24.80	9.65	-16.41
4	3.5 x bow		.528	.007	.078	.508	24.15	10.93	-18.23
2	1.5 x stern	0.556	.738	.001	.038	.656	22.16	7.20	-18.52
3	1.0 x bow		.738	.002	.040	.631	21.59	7.53	-18.18
4	3.5 x bow		.7[illegible]5	.000	.038	.616	21.27	7.63	-17.13
2	1.5 x stern	0.774	.797	.000	.048	.728	17.55	3.73	-12.30
3	1.0 x bow		.791	.003	.046	.709	17.41	3.57	-14.15
4	3.5 x bow		.[illegible]2	.001	.047	.700	17.42	3.84	-15.07
2	1.5 x stern	1.017	.828	.002	.029	.769	14.03	2.15	-9.31
3	1.0 x bow		.823	.002	.030	.757	13.95	2.25	-9.26
4	3.5 x bow		.821	.000	.030	.752	13.92	2.02	-9.74
2	1.5 x stern	1.178	.788	.005	.044	.781	11.59	1.59	-8.21
3	1.0 x bow		.767	.003	.043	.768	11.30	1.64	-8.89
4	3.5 x bow		.768	.005	.043	.765	11.31	1.67	-8.62

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).

APPENDIX A

RESULTS OF EXPERIMENT 1

Corresponding to

Trim 1.5 ft (0.457 m) by the Stern

Displacement 27,380 Tons (27,830 tonnes)

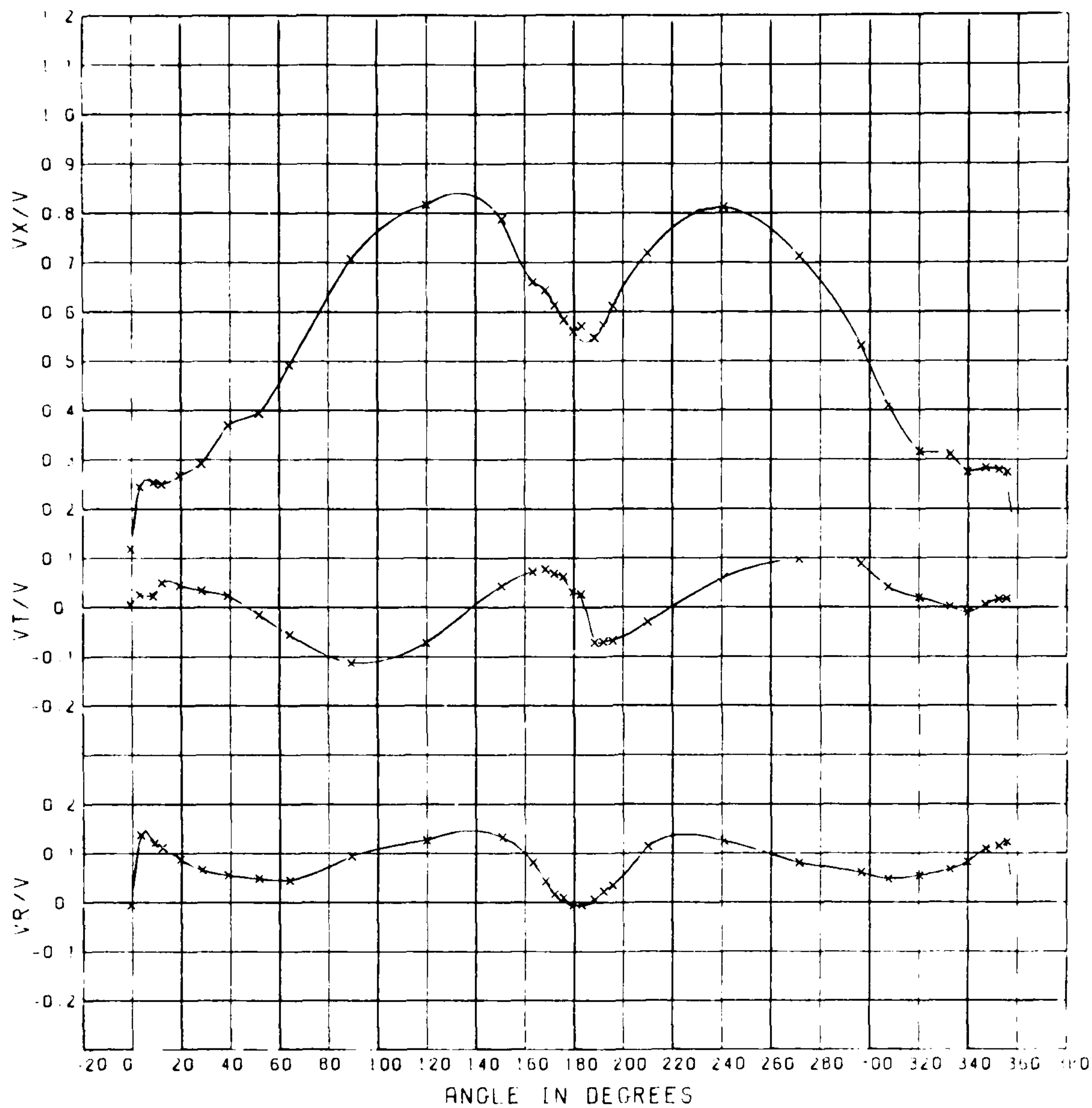


Figure A1 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.35[illegible]
EXPERIMENT 1

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,38[illegible] TONS

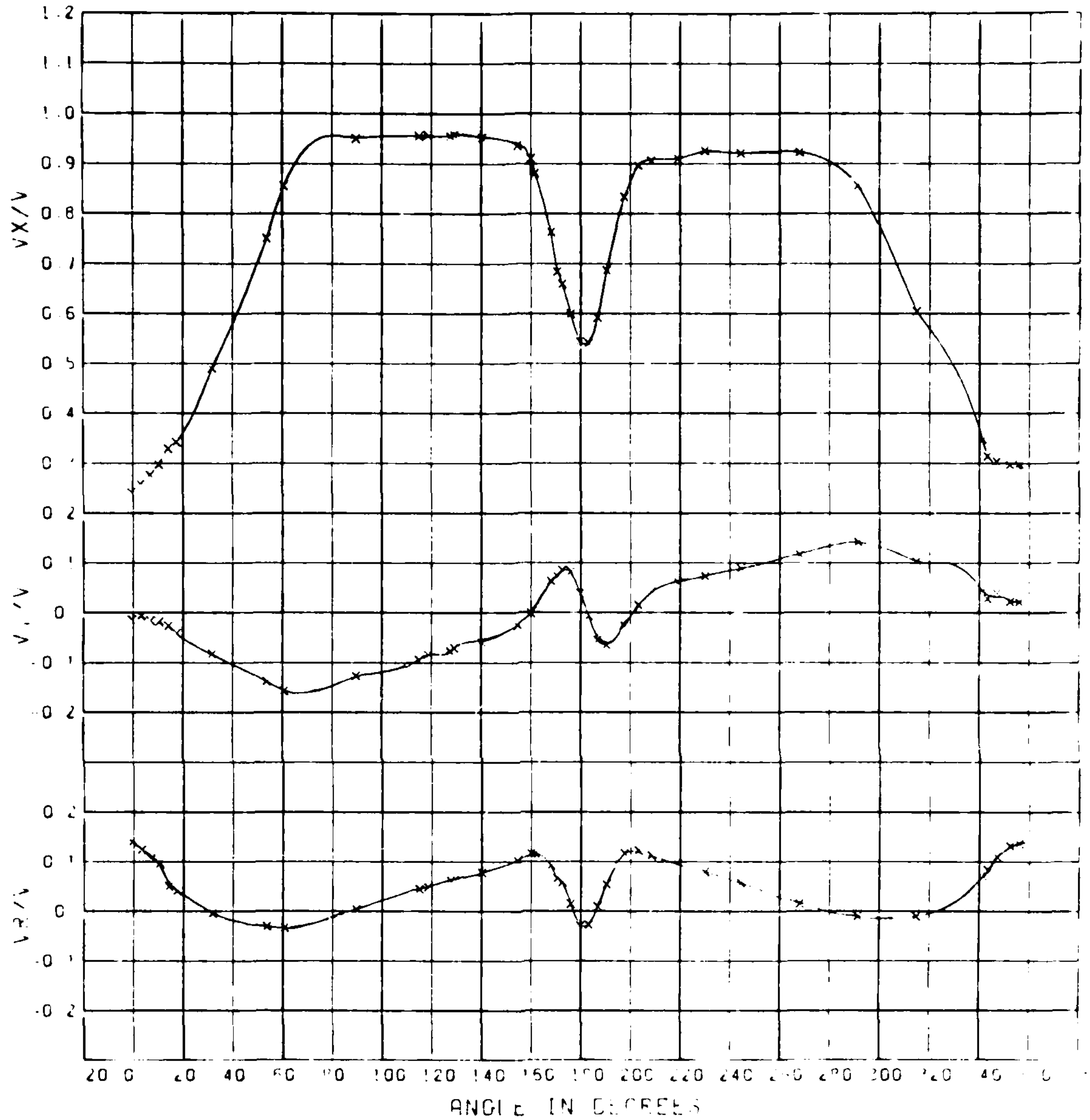


Figure A2 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.556
EXPERIMENT 1

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,380 TONS

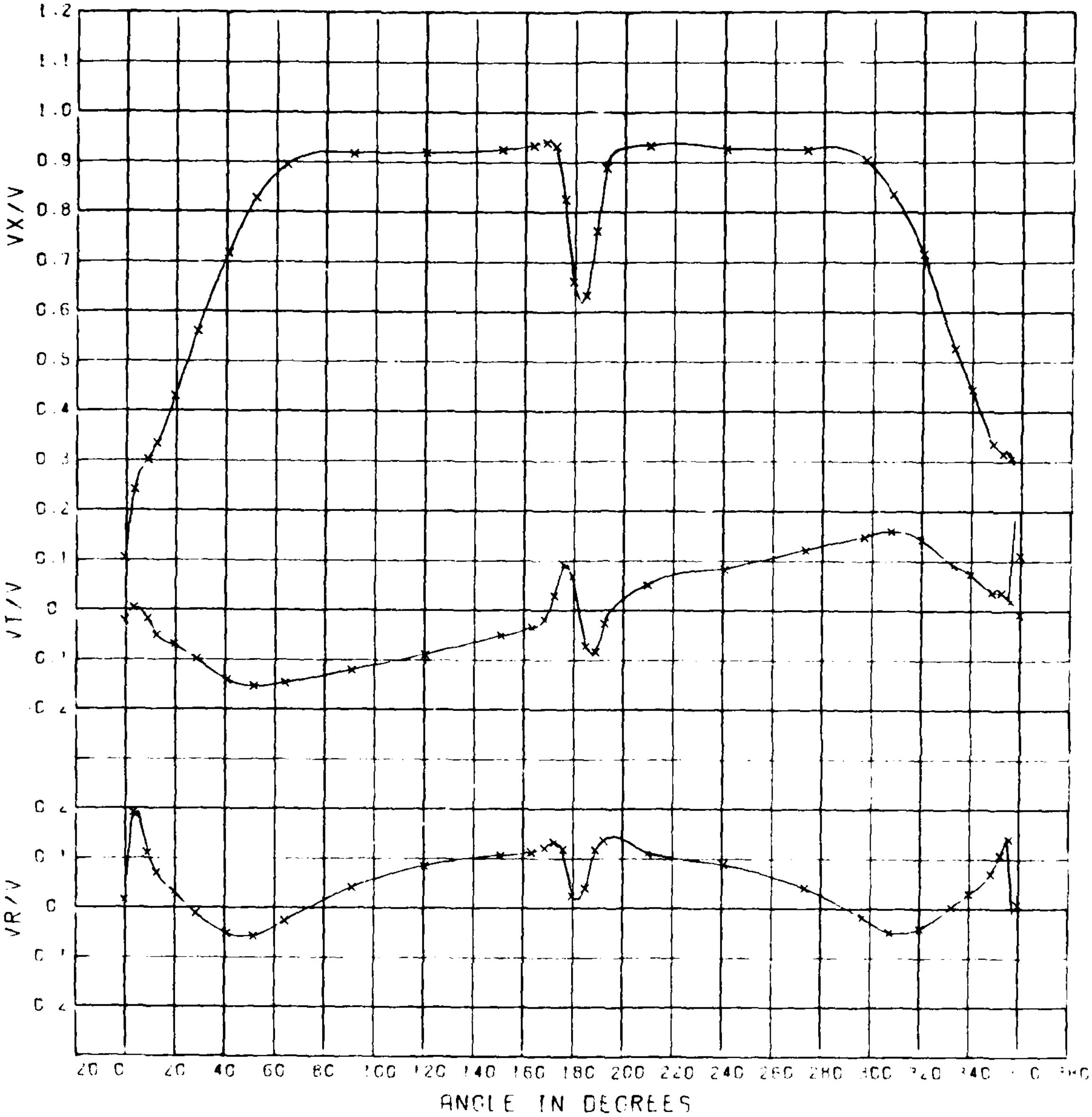


Figure A3 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.774
EXPERIMENT 1

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,380 TONS

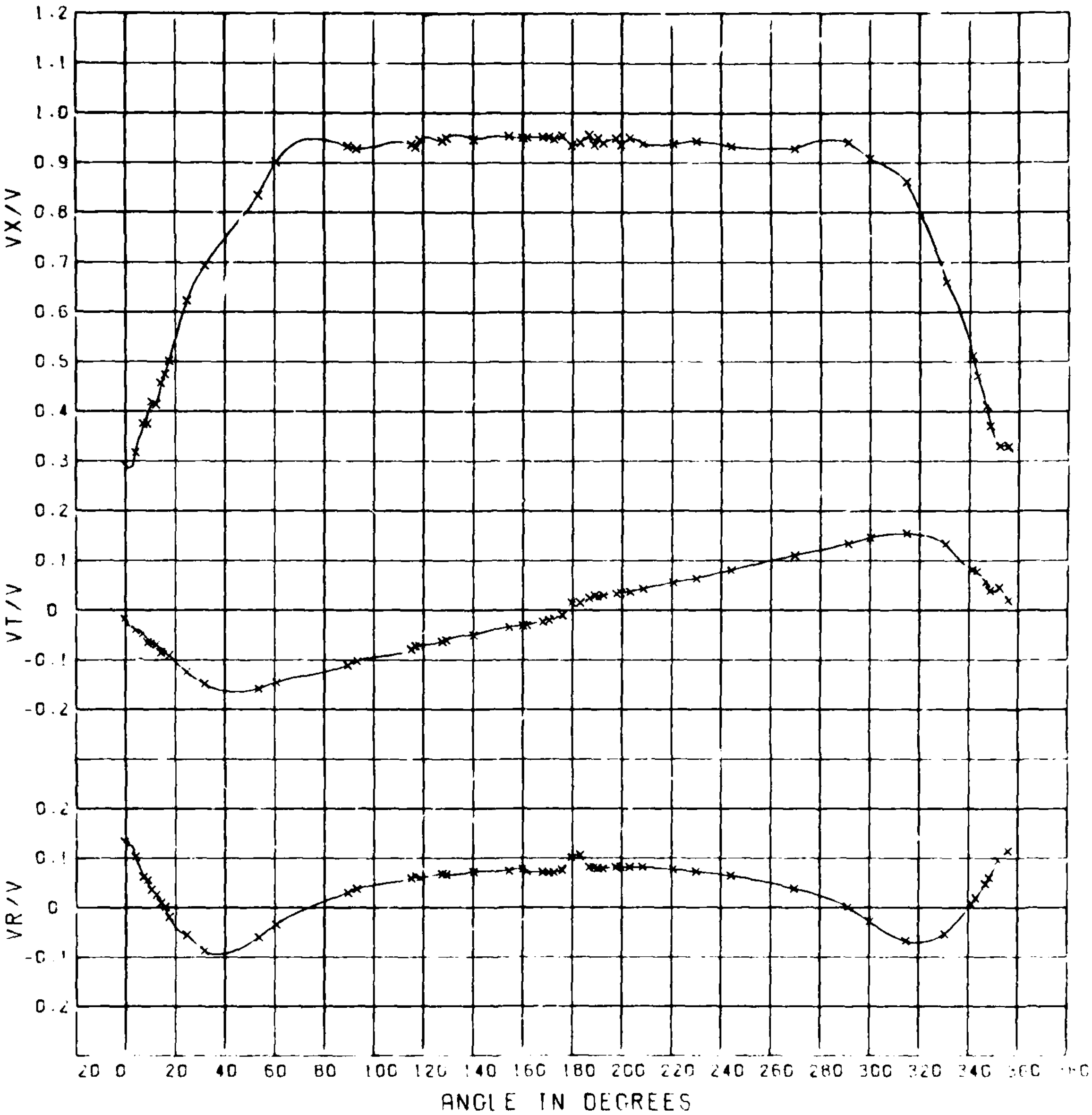


Figure A4 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 1.017
EXPERIMENT I

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,380 TONS

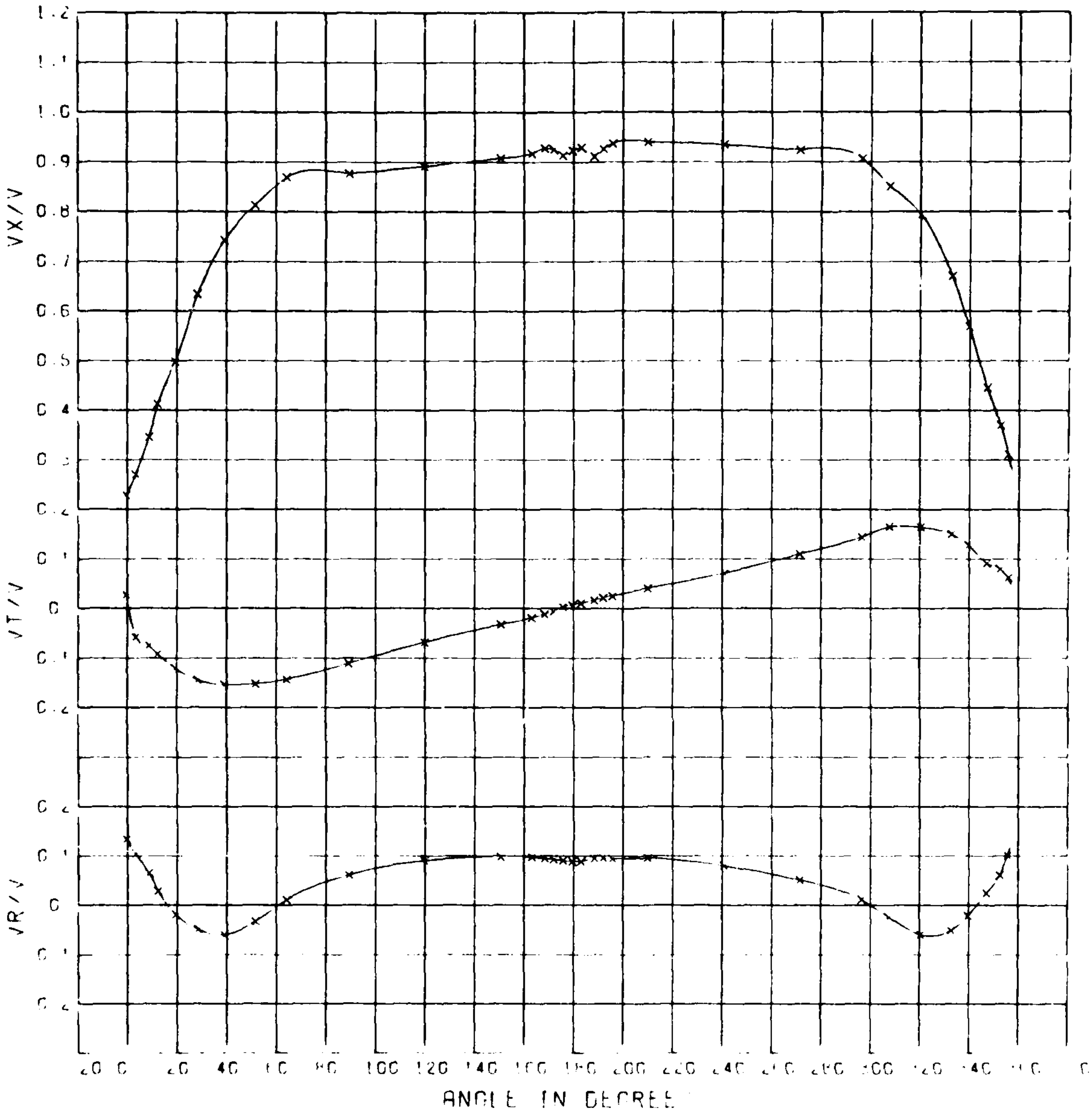


Figure A5 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 1.178
EXPERIMENT 1

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,330 TONS

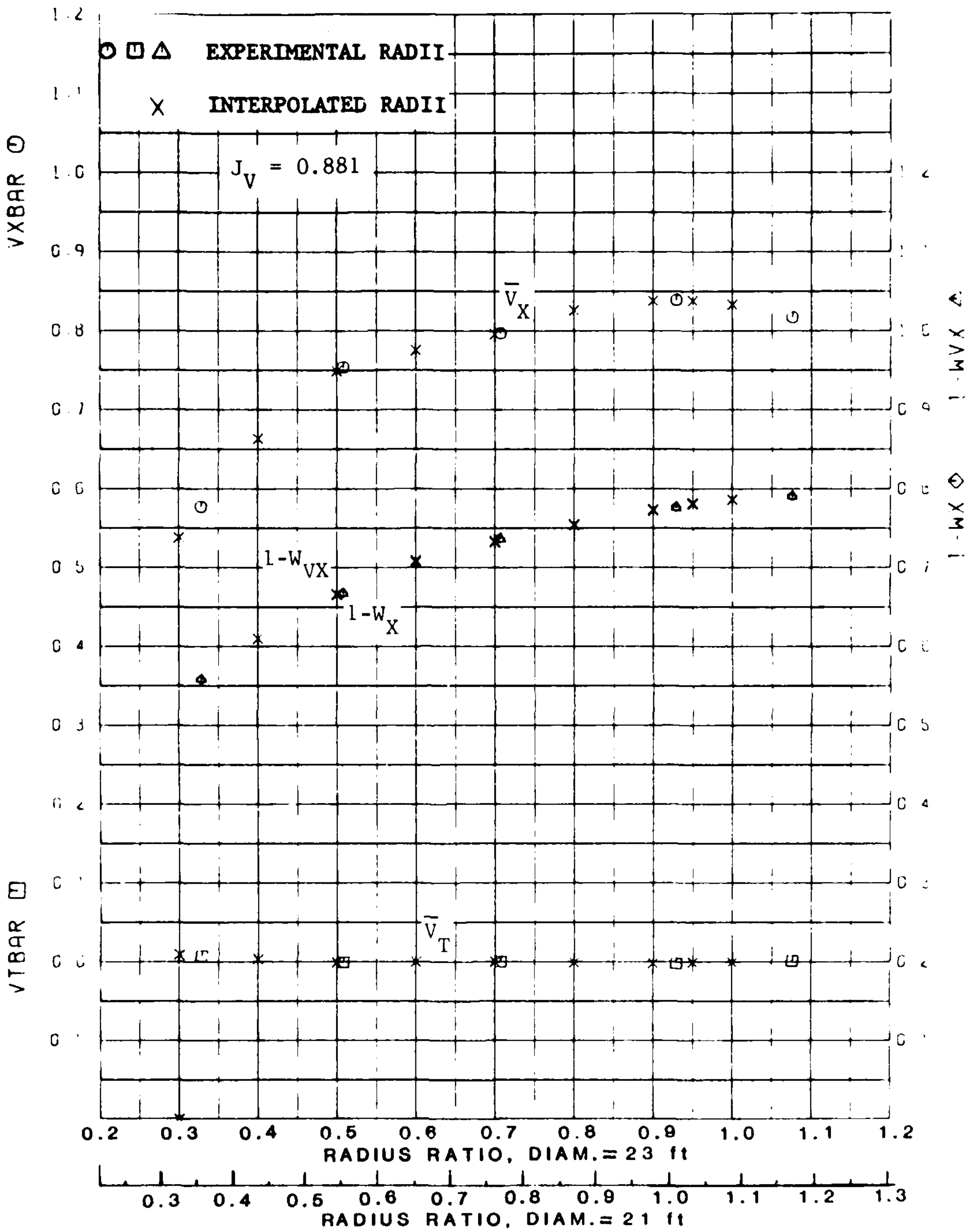


Figure A6 - RADIAL DISTRIBUTION OF THE MEAN VELOCITY COMPONENT RATIOS
EXPERIMENT 1

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,380 TONS

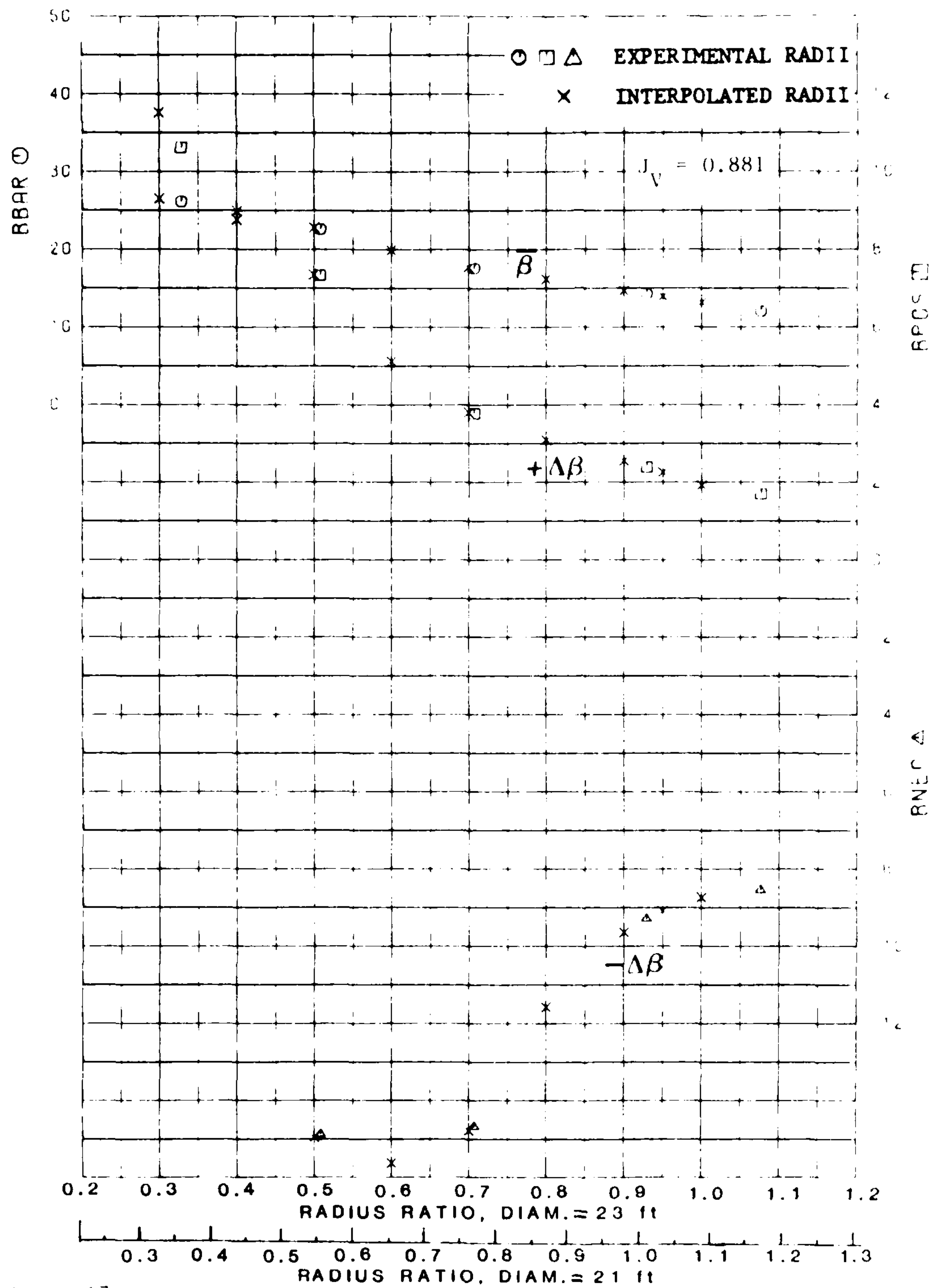


Figure A7 - RADIAL DISTRIBUTION OF THE MEAN ADVANCE ANGLE AND THE MAXIMUM VARIATIONS OF THE ADVANCE ANGLE FOR MODEL 5326
EXPERIMENT I

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,380 TONS

Table A1 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES
EXPERIMENT 1

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,380 TONS
D = 21 ft (6.4m), J_V = 1.01

RADIUS =	.359	.556	.774	1.017	1.178	.200	.300	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	.577	.754	.797	.839	.817	.339	.499	.625	.717	.763	.783	.806	.833	.839
VTBAR =	.007	-.001	.000	-.002	.001	.020	.011	.005	.001	-.000	.000	-.000	-.002	-.002
VRBAR =	.084	.039	.049	.027	.044	.159	.108	.071	.047	.043	.049	.044	.033	.027
1-WVX =	.492	.613	.701	.753	.773	0.000	.435	.509	.582	.636	.676	.706	.731	.751
1-WX =	.493	.614	.704	.755	.775	0.000	.435	.509	.581	.639	.678	.708	.732	.753
BBAR =	27.18	23.56	18.32	14.86	12.56	27.87	27.84	26.57	24.7[illegible]	22.24	19.79	17.95	16.52	15.10
BPOS =	10.33	7.64	3.89	2.50	1.76	20.12	12.85	9.89	7.94	6.53	4.65	3.60	3.14	2.60
THETA =	115.00	77.50	200.00	75.00	202.50	172.50	117.50	112.50	102.50	77.50	80.00	77.50	75.00	75.00
BNEG =	-19.9[illegible]	-15.48	-15.31	-9.71	-8.93	-36.70	-23.31	-18.33	-16.09	-16.07	-16.12	-14.34	-11.53	-9.89
THETA =	0.00	0.00	0.00	0.00	0.00	62.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

Table A2 - HARMONIC ANALYSIS OF LONGITUDINAL VELOCITY COMPONENT RATIOS
AT THE EXPERIMENTAL RADII
EXPERIMENT 1

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,380 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359								
AMPLITUDE =	-.2397	-.1439	.0665	-.0158	.0171	-.0152	-.0318	-.0044
RADIUS = .556								
AMPLITUDE =	-.2147	-.2223	-.0187	-.0505	.0445	-.0313	.0194	-.0271
RADIUS = .774								
AMPLITUDE =	-.2231	-.1766	-.0790	-.0639	.0355	-.0259	.0160	-.0235
RADIUS = 1.017								
AMPLITUDE =	-.1894	-.1786	-.0315	-.0495	-.0216	-.0149	-.0155	-.0105
RADIUS = 1.173								
AMPLITUDE =	-.1819	-.1273	-.0877	-.0523	-.0282	-.0235	-.0154	-.0124

Table A3 - HARMONIC ANALYSIS OF LONGITUDINAL VELOCITY COMPONENT RATIOS
AT THE INTERPOLATED RADII
EXPERIMENT 1

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,380 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200								
AMPLITUDE =	-.2722	.0124	.1416	.0280	-.0484	.0128	-.0335	.0321
RADIUS = .300								
AMPLITUDE =	-.2499	-.0983	.0888	-.0011	-.0027	-.0062	-.0119	.0073
RADIUS = .400								
AMPLITUDE =	-.2334	-.1696	.0421	-.0248	.0277	-.0200	.0042	-.0111
RADIUS = .500								
AMPLITUDE =	-.2294	-.2116	.0014	-.0428	.0427	-.0287	.0148	-.0232
RADIUS = .600								
AMPLITUDE =	-.2124	-.2122	-.0346	-.0552	.0355	-.0305	.0199	-.0270
RADIUS = .700								
AMPLITUDE =	-.2371	-.1909	-.0637	-.0622	.0172	-.0282	.0195	-.0256
RADIUS = .800								
AMPLITUDE =	-.2315	-.1713	-.0813	-.0613	.0016	-.0237	.0108	-.0212
RADIUS = .900								
AMPLITUDE =	-.1957	-.1577	-.0382	-.0536	-.0112	-.0173	.0051	-.0144
RADIUS = 1.000								
AMPLITUDE =	-.1903	-.1454	-.0913	-.0498	-.0204	-.0149	-.0146	-.0108

Table A4 - HARMONIC ANALYSIS OF TANGENTIAL VELOCITY COMPONENT RATIOS
AT THE EXPERIMENTAL RADII
EXPERIMENT 1

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,380 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.0636	-.0156	.0569	-.0108	.0144	-.0099	.0059	-.0036
RADIUS = .556 AMPLITUDE =	-.1263	-.0324	.0094	-.0038	.0127	-.0129	.0103	-.0091
RADIUS = .774 AMPLITUDE =	-.1355	-.0366	-.0123	-.0056	.0080	-.0023	.0070	-.0078
RADIUS = 1.017 AMPLITUDE =	-.1304	-.0484	-.0235	-.0045	-.0024	.0036	.0033	.0018
RADIUS = 1.178 AMPLITUDE =	-.1329	-.0569	-.0279	-.0118	-.0074	-.0036	-.0033	-.0029

Table A5 - HARMONIC ANALYSIS OF TANGENTIAL VELOCITY COMPONENT RATIOS
AT THE INTERPOLATED RADII
EXPERIMENT 1

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,380 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	.[illegible]	.0321	.1147	-.0191	.0140	.0012	-.0028	.0056
RADIUS = .300 AMPLITUDE =	[illegible]	.0168	.0763	-.0136	.0144	-.0067	.0032	-.0007
RADIUS = .400 AMPLITUDE =	[illegible]	-.0130	.0449	-.0099	.0142	-.0115	.0074	-.0053
RADIUS = .500 AMPLITUDE =	[illegible]	-.0270	.0262	-.0064	.0134	-.0133	.0098	-.0082
RADIUS = .600 AMPLITUDE =	-.1233	-.0328	.0041	-.0026	.0121	-.0103	.0098	-.0094
RADIUS = .700 AMPLITUDE =	[illegible]	-.0745	-.0061	-.0009	.0131	-.0053	.0084	-.0090
RADIUS = .800 AMPLITUDE =	-.1347	-.0378	-.0137	-.0007	.0067	-.0007	.0062	-.0058
RADIUS = .900 AMPLITUDE =	[illegible]	-.0426	-.0187	-.0018	.0022	.0033	.0034	-.0003
RADIUS = 1.000 AMPLITUDE =	[illegible]	-.0476	-.0228	-.0043	-.0018	.0038	.0007	.0018

Table A6 - INPUT DATA FOR WAKE SURVEY ANALYSES
EXPERIMENT 1

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 27,380 TONS

RADIUS RATIO = 0.359

ANGLE	VX/V	VT/V	VR/V
-.5	.118	.005	-.005
3.3	.244	.025	.137
8.7	.253	.022	.120
12.2	.244	.050	.111
19.5	.267	.044	.087
28.3	.291	.033	.065
39.0	.369	.023	.055
51.6	.394	-.015	.046
64.1	.432	-.057	.044
89.3	.707	-.114	.093
119.8	.816	-.073	.125
150.5	.778	.039	.130
150.8	.798	.046	.135
163.2	.661	.072	.081
169.3	.644	.077	.043
172.0	.614	.068	.015
175.7	.584	.002	.009
179.5	.560	.030	-.007
183.0	.570	.026	-.005
188.4	.547	-.072	.004
192.0	.572	-.071	.022
195.7	.611	-.059	.035
210.0	.719	-.030	.114
240.7	.811	.059	.125
271.4	.713	.048	.081
296.5	.531	.044	.060
307.5	.410	.041	.047
320.2	.316	.020	.054
332.9	.310	.011	.066
339.8	.274	-.011	.082
347.1	.243	.005	.109
352.5	.279	.015	.114
355.9	.275	.018	.123
359.5	.118	.005	-.005

RADIUS RATIO = 0.556

ANGLE	VX/V	VT/V	VR/V
-.6	.241	-.015	.140
3.2	.258	-.007	.124
6.9	.276	-.015	.105
10.4	.297	-.019	.093
14.1	.329	-.027	.050
17.4	.342	-.042	.041
31.7	.490	-.063	-.004
53.5	.750	-.137	-.031
60.6	.856	-.157	-.034
89.4	.953	-.123	.004
89.6	.946	-.131	.002
115.0	.956	-.095	.044
118.5	.958	-.085	.049
127.6	.955	-.078	.062
129.1	.958	-.071	.063
140.1	.954	-.057	.077
140.2	.952	-.061	.079
154.4	.934	-.025	.102
154.5	.937	-.026	.103
159.9	.910	-.002	.115
161.6	.881	.011	.116
167.2	.784	.061	.100
168.6	.743	.065	.085
170.5	.684	.073	.065
172.5	.659	.085	.054
175.9	.599	.082	.014
179.7	.544	.038	-.031
183.2	.540	-.008	-.025
186.8	.592	-.056	.009
190.3	.687	-.066	.054
197.6	.834	-.025	.115
203.1	.897	.015	.123
209.4	.906	.041	.112
219.2	.909	.060	.095
230.0	.925	.073	.080
244.4	.920	.089	.057
267.9	.922	.116	.017
291.3	.856	.142	-.010
314.7	.604	.103	-.011
341.3	.347	.043	.071
343.2	.314	.029	.084
346.9	.303	.039	.110
352.2	.297	.022	.132
355.9	.298	.021	.136
359.4	.241	-.015	.140

RADIUS RATIO = 0.774

ANGLE	VX/V	VT/V	VR/V
-.4	.103	-.023	.015
3.1	.242	.004	.191
8.8	.300	-.019	.110
12.3	.334	-.052	.070
19.5	.429	-.070	.031
28.3	.560	-.099	-.012
40.6	.705	-.144	-.051
40.7	.728	-.139	-.053
51.5	.822	-.161	-.059
51.6	.832	-.148	-.058
64.0	.900	-.143	-.025
64.1	.888	-.152	-.025
91.0	.917	-.122	.040
120.0	.912	-.091	.083
120.2	.924	-.088	.084
150.4	.923	-.054	.107
150.8	.927	-.050	.104
163.1	.930	-.034	.111
163.2	.935	-.035	.113
168.4	.939	-.020	.120
172.2	.932	.028	.132
175.8	.825	.042	.115
179.5	.661	.069	.024
184.7	.632	-.073	.040
189.7	.761	-.084	.117
192.3	.887	-.026	.135
209.9	.933	.051	.110
240.5	.927	.082	.089
273.2	.924	.121	.041
296.9	.404	.148	-.019
307.6	.836	.160	-.049
320.1	.717	.143	-.042
332.8	.526	.091	.002
339.9	.443	.074	.029
348.6	.335	.036	.070
352.3	.316	.037	.107
356.0	.307	.019	.139
359.5	.118	.008	.001
359.6	.103	-.023	.015

CONTINUED

Table A6 - INPUT DATA FOR WAKE SURVEY ANALYSES
EXPERIMENT 1
TRIMMED 1.5 FEET BY THE STERN DISPLACEMENT 27,380 TONS

RADIUS RATIO = 1.017

ANGLE	VX/V	VT/V	VR/V
[illegible]	.293	-.019	.132
	.316	-.051	.110
	.316	-.029	.094
[illegible]	.374	-.047	.061
[illegible].7	.375	-.066	.055
10.4	.418	-.066	.035
12.3	.413	-.070	.025
14.1	.456	-.046	.009
15.8	.474	-.045	.001
17.4	.500	-.042	-.020
24.5	.623	-.125	-.055
31.7	.693	-.149	-.084
53.5	.834	-.159	-.061
60.6	.901	-.148	-.035
89.4	.942	-.110	.029
93.2	.927	-.103	.037
115.0	.937	-.079	.055
116.9	.931	-.073	.062
119.5	.946	-.072	.060
127.6	.944	-.063	.067
129.1	.950	-.060	.065
140.2	.947	-.050	.072
154.4	.955	-.035	.073
159.9	.950	-.032	.077
161.6	.951	-.029	.073
167.2	.952	-.023	.073
168.6	.951	-.024	.070
170.5	.951	-.020	.070
172.5	.947	-.019	.070
175.9	.957	-.012	.075
176.0	.950	-.009	.074
179.6	.934	.015	.101
183.1	.940	.015	.106
186.8	.955	.024	.080
188.8	.935	.029	.081
190.3	.949	.027	.079
192.3	.940	.029	.078
197.6	.948	.032	.080
199.5	.935	.034	.081
203.1	.950	.037	.081
208.3	.934	.042	.080
220.6	.938	.055	.077
230.0	.943	.063	.072
244.0	.933	.080	.064
269.5	.929	.109	.039
291.3	.940	.133	.000
300.0	.909	.146	-.029
314.7	.861	.154	-.069
330.4	.665	.132	-.055
341.3	.511	.080	.005
343.1	.470	.078	.013
346.9	.411	.057	.047
348.4	.371	.039	.059
352.2	.337	.050	.092
355.9	.330	.020	.114
359.4	.276	.001	.129

RADIUS RATIO = 1.178

ANGLE	VX/V	VT/V	VR/V
-.5	.228	.027	.133
3.3	.270	-.058	.103
8.7	.345	-.076	.064
12.2	.412	-.043	.025
19.5	.458	-.121	-.020
28.3	.634	-.145	-.050
39.0	.742	-.155	-.061
51.6	.813	-.153	-.034
64.1	.869	-.144	.010
89.3	.876	-.112	.060
119.8	.891	-.049	.089
150.5	.906	-.032	.095
150.8	.909	-.034	.095
163.2	.917	-.020	.097
168.3	.927	-.013	.094
172.0	.925	-.007	.092
175.7	.913	.002	.090
179.5	.923	.005	.089
183.0	.929	.010	.084
188.4	.911	.015	.094
192.0	.926	.021	.095
195.7	.936	.025	.094
210.0	.939	.039	.095
240.7	.935	.070	.079
271.4	.922	.109	.050
296.5	.907	.143	.011
307.5	.850	.164	-.024
320.2	.794	.164	-.060
332.8	.670	.150	-.052
339.8	.566	.128	-.022
347.1	.445	.041	.024
352.5	.370	.079	.060
355.8	.311	.062	.100
359.5	.228	.027	.133

APPENDIX B
RESULTS OF EXPERIMENT 2

Corresponding to
Trim 1.5 ft (0.457 m) by the Stern
Displacement 26,380 Tons (26,810 tonnes)

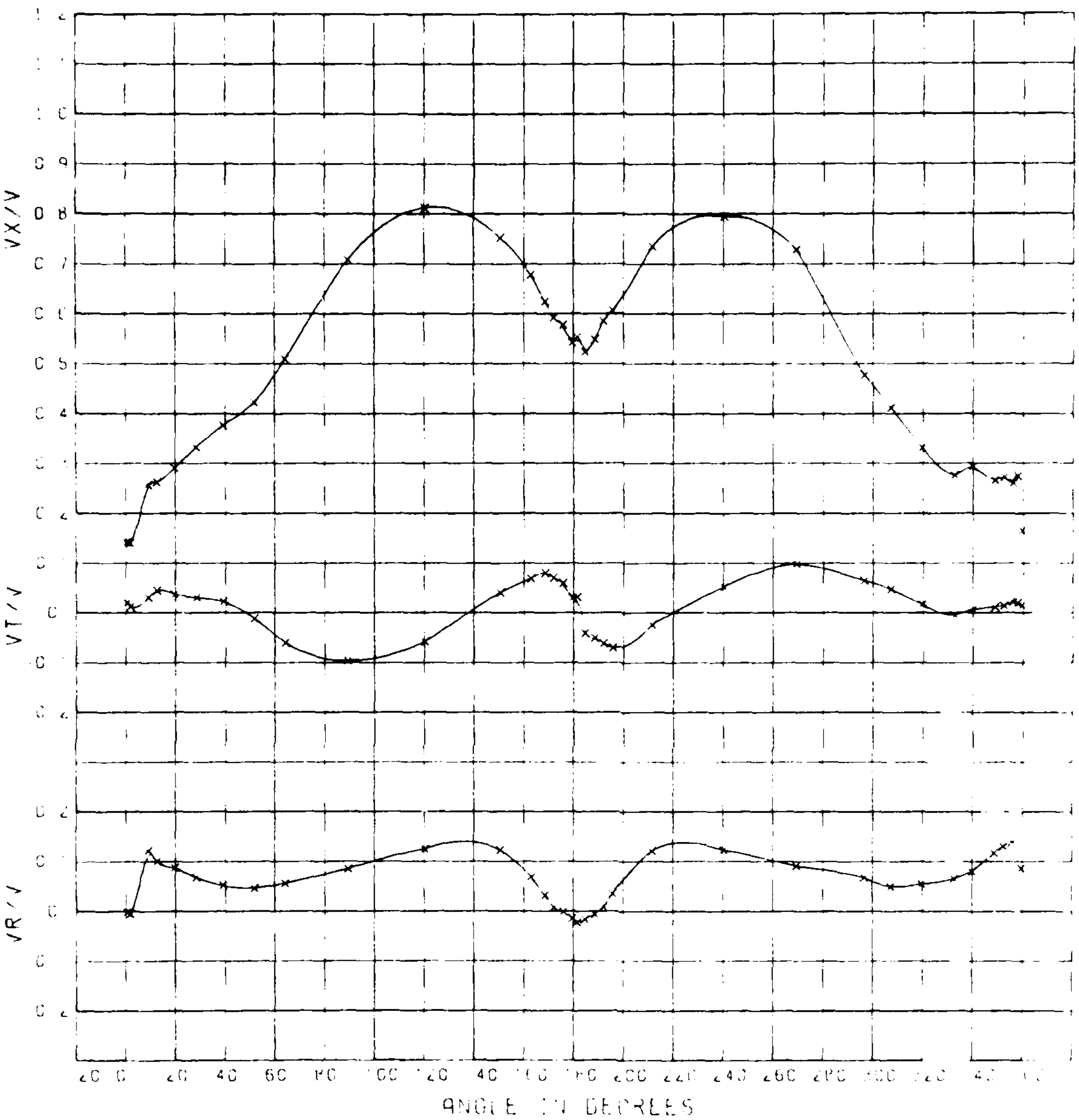


Figure B1 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.359
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,390 TONS

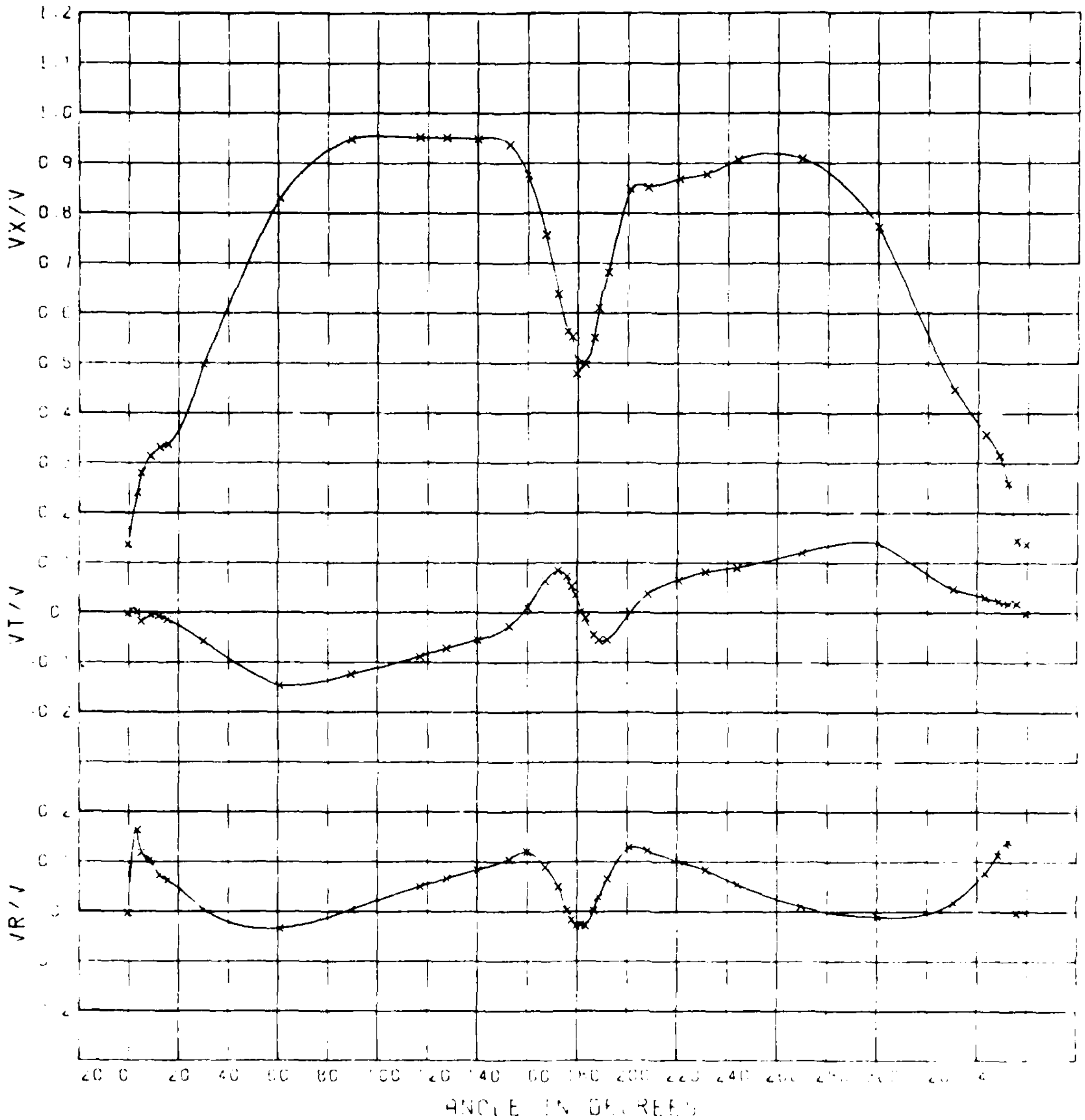


Figure B2 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.556
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,390 TONS

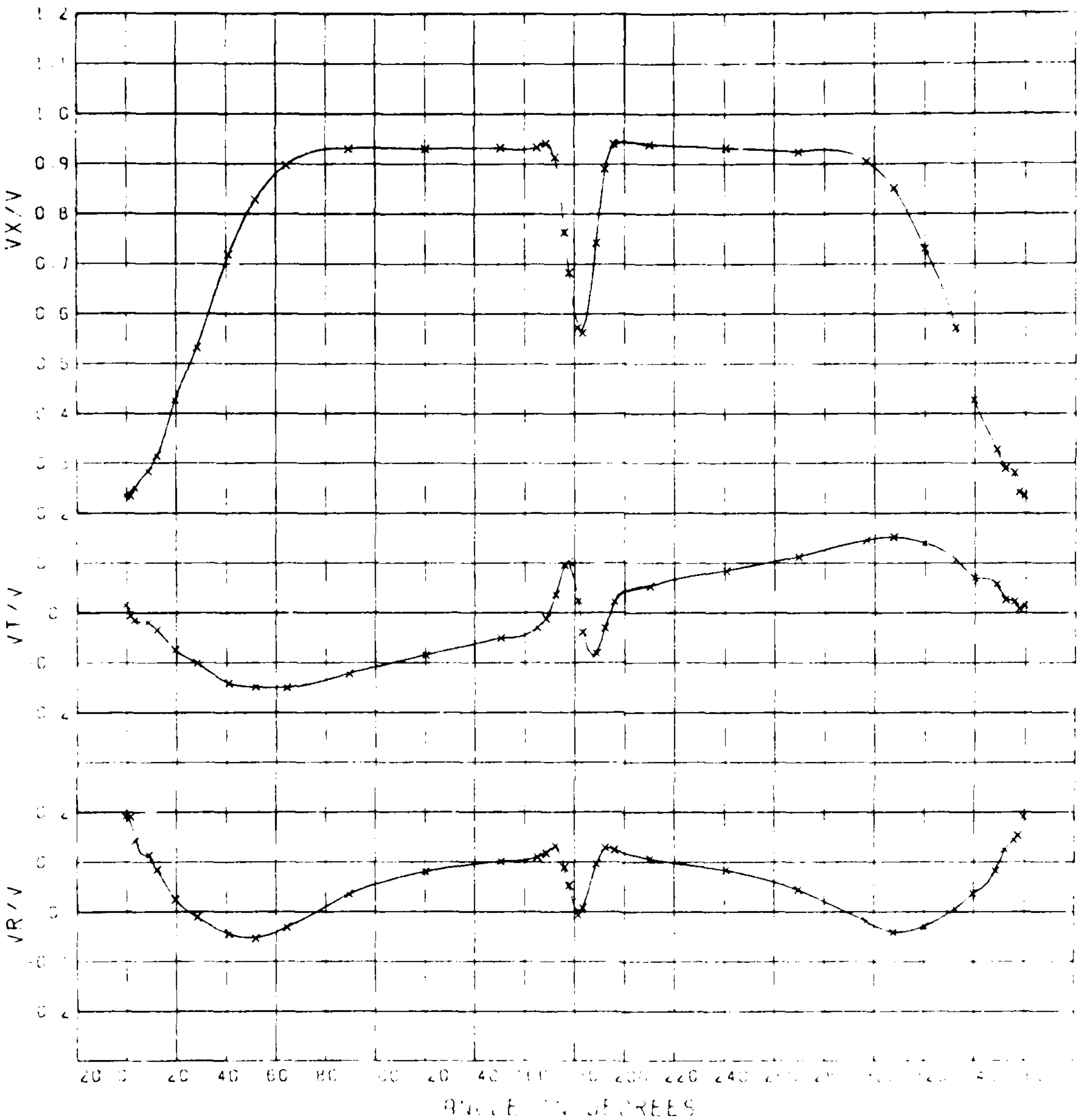


Figure B3 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.774
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,3 0 TONS

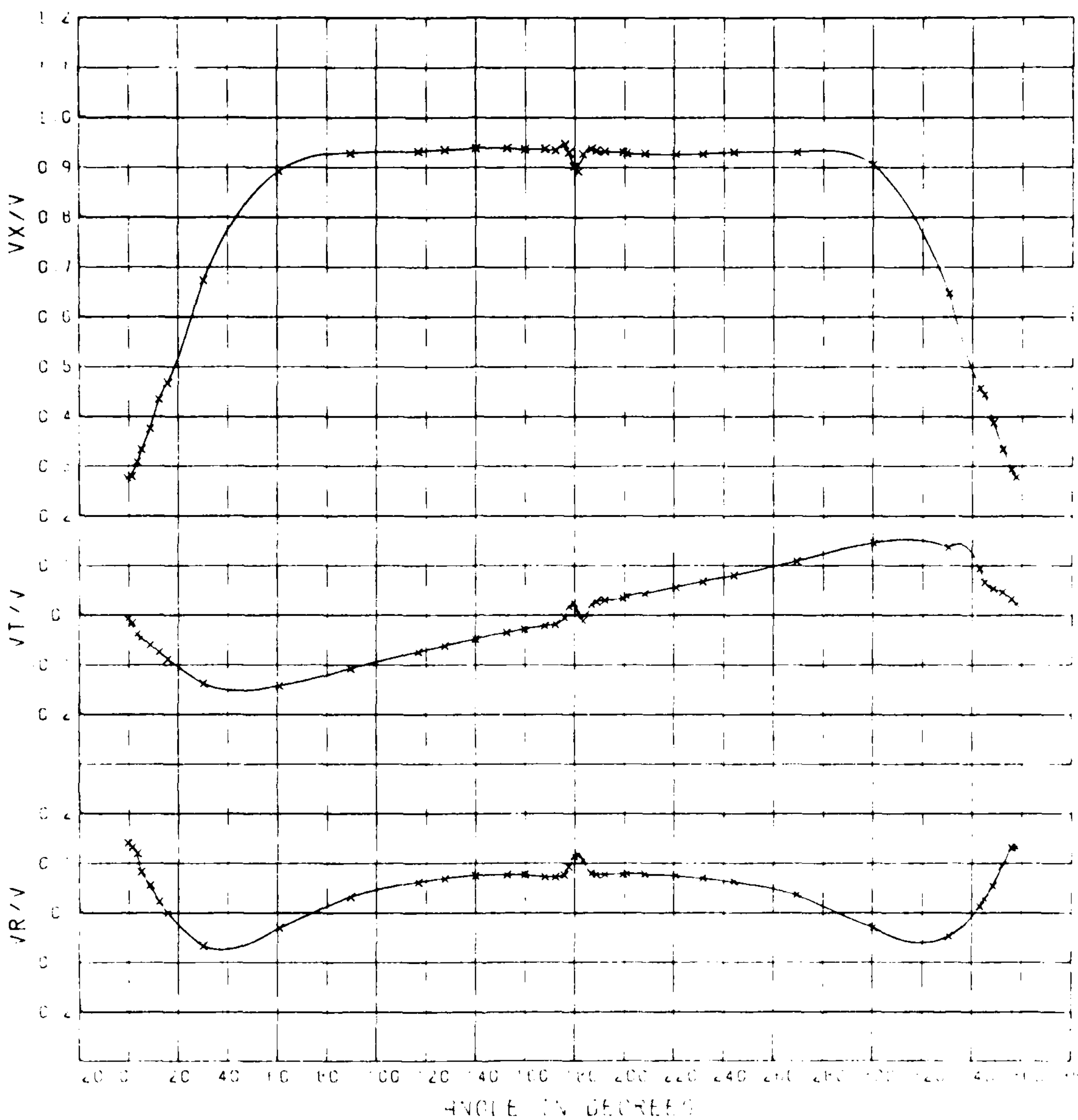


Figure B4 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 1.017
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,390 TONS

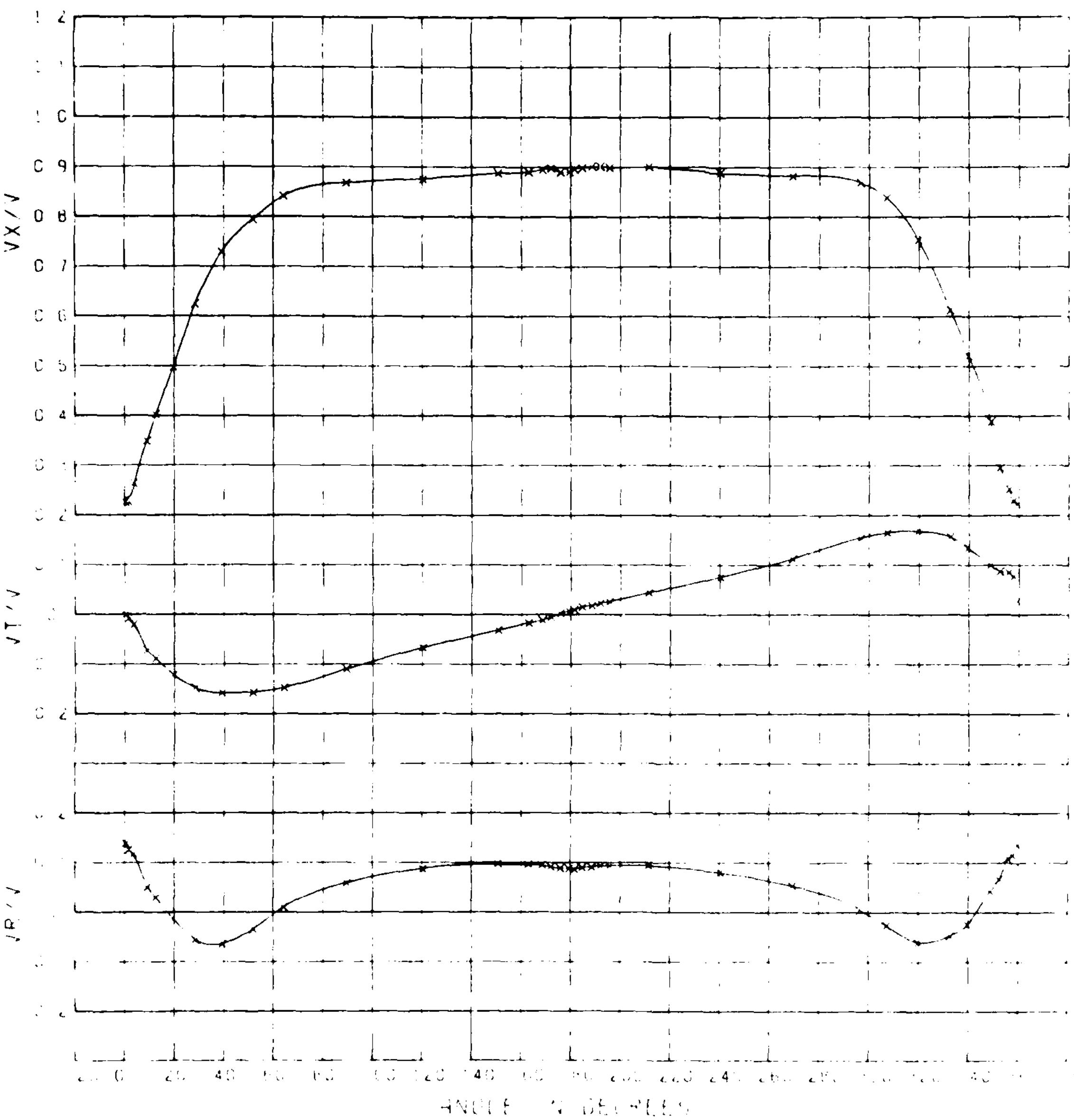


Figure B5 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 1.178
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,3?0 TONS

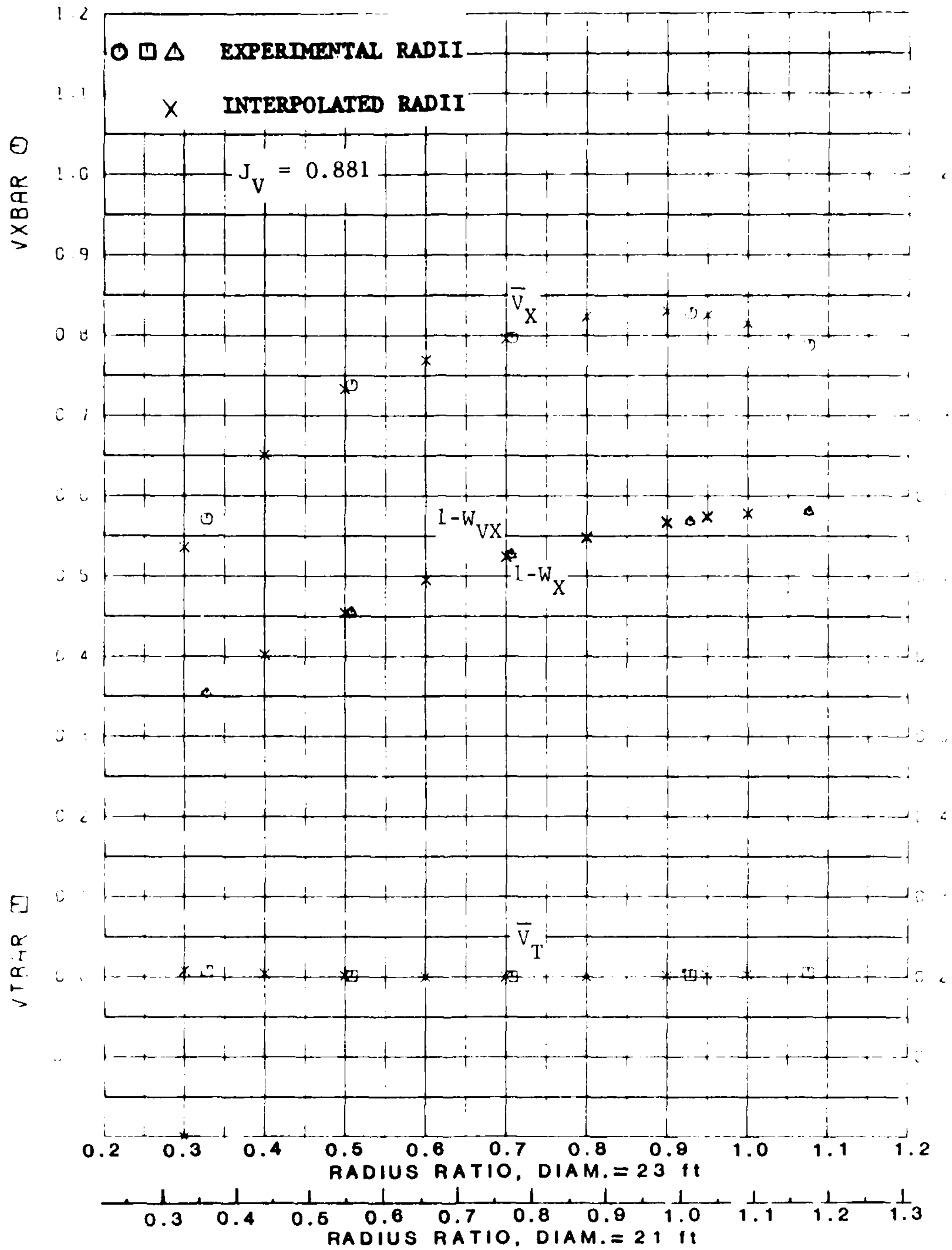


Figure B6 - RADIAL DISTRIBUTION OF THE MEAN VELOCITY COMPONENT RATIOS
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,390 TONS

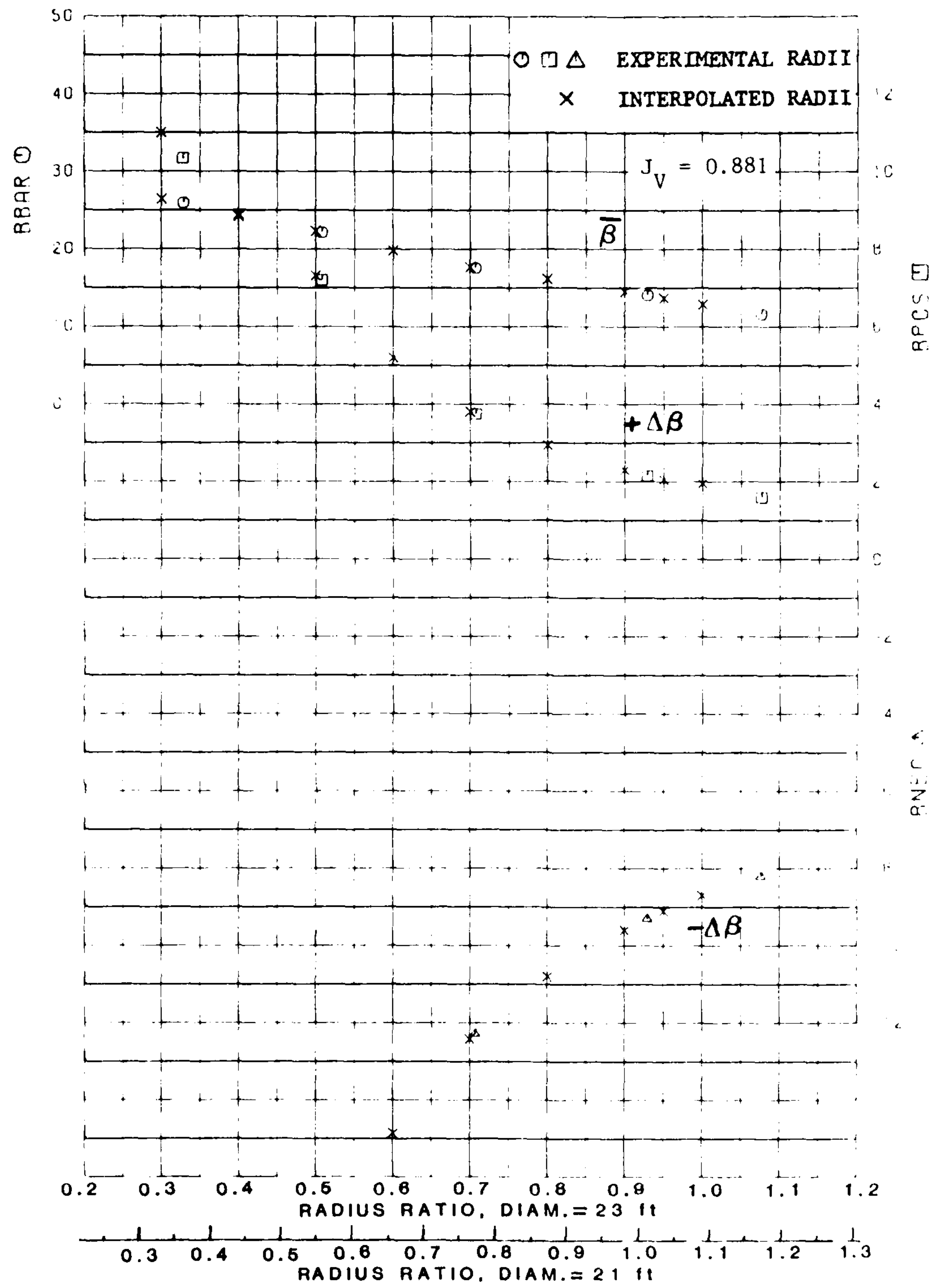


Figure B7 - RADIAL DISTRIBUTION OF THE MEAN ADVANCE ANGLE AND THE MAXIMUM VARIATIONS OF THE ADVANCE ANGLE FOR MODEL 5326
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,390 TONS

Table B1 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,390 TONS
D = 21 ft (6.4 m), J_V = 1.01

RADIUS	= .359	.556	.774	1.017	1.178	.200	.300	.400	.500	.600	.700	.800	.900	1.001
VXBAR	= .571	.738	.797	.828	.788	.358	.500	.615	.702	.753	.781	.806	.827	.829
VTBAR	= .007	.001	.000	.032	.005	.015	.010	.005	.002	.001	.000	.000	.000	.001
VRBAR	= .082	.038	.048	.029	.044	.155	.105	.069	.045	.042	.047	.043	.032	.029
1-WVX	= .495	.606	.694	.747	.764	0.000	.444	.510	.575	.628	.669	.700	.726	.745
1-WX	= .496	.607	.695	.748	.764	0.000	.444	.510	.575	.630	.670	.702	.727	.748
BBAR	= 26.96	23.10	18.32	14.66	12.12	29.35	27.96	26.21	24.25	21.95	19.72	17.94	16.45	14.92
BPOS THETA	= 10.63 =115.00	7.49 95.00	3.91 80.00	2.27 82.50	1.66 170.00	22.59 222.50	12.00 117.50	9.81 112.50	8.20 102.50	6.50 92.50	4.78 85.00	3.68 80.00	2.92 80.00	2.35 82.50
BNEG THETA	=-19.71 = 0.00	-19.30 357.50	-12.83 0.00	-9.72 0.00	-8.59 357.50	-30.45 55.00	-21.04 2.50	-19.86 0.00	-19.32 357.50	-17.45 357.50	-14.29 357.50	-12.39 0.00	-10.96 0.00	-9.88 0.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

Table B2 - HARMONIC ANALYSIS OF LONGITUDINAL VELOCITY COMPONENT RATIOS
AT THE EXPERIMENTAL RADII
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359								
AMPLITUDE =	-.2320	-.1425	.0587	-.0175	.0084	-.0198	.0023	-.0053
RADIUS = .556								
AMPLITUDE =	-.2031	-.2272	-.0183	-.0536	.0301	-.0378	.0215	-.0290
RADIUS = .774								
AMPLITUDE =	-.1991	-.1866	-.0741	-.0712	.0367	-.0294	.0193	-.0235
RADIUS = 1.017								
AMPLITUDE =	-.1888	-.1429	-.0908	-.0491	-.0233	-.0133	-.0074	-.0063
RADIUS = 1.178								
AMPLITUDE =	-.1807	-.1273	-.0882	-.0520	-.0294	-.0191	-.0133	-.0097

Table B3 - HARMONIC ANALYSIS OF LONGITUDINAL VELOCITY COMPONENT RATIOS
AT THE INTERPOLATED RADII
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	-.2728	.0099	.1392	.0361	-.0390	.0126	-.0279	.0336
RADIUS = .300 AMPLITUDE =	-.2453	-.0947	.0866	.0002	-.0061	-.0096	-.0074	.0071
RADIUS = .400 AMPLITUDE =	-.2240	-.1696	.0406	-.0284	.0163	-.0255	.0079	-.0125
RADIUS = .500 AMPLITUDE =	-.2088	-.2148	.0010	-.0498	.0281	-.0352	.0181	-.0250
RADIUS = .600 AMPLITUDE =	-.2027	-.2189	-.0327	-.0636	.0257	-.0366	.0227	-.0286
RADIUS = .700 AMPLITUDE =	-.2010	-.2002	-.0595	-.0703	.0150	-.0329	.0224	-.0264
RADIUS = .800 AMPLITUDE =	-.1981	-.1808	-.0770	-.0673	.0023	-.0262	.0154	-.0204
RADIUS = .900 AMPLITUDE =	-.1941	-.1609	-.0858	-.0557	-.0120	-.0173	.0028	-.0112
RADIUS = 1.000 AMPLITUDE =	-.1896	-.1451	-.0904	-.0496	-.0220	-.0134	-.0062	-.0066

Table B4 - HARMONIC ANALYSIS OF TANGENTIAL VELOCITY COMPONENT RATIOS
AT THE EXPERIMENTAL RADII
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359								
AMPLITUDE =	-.0532	-.0069	.0527	-.0119	.0131	-.0104	.0059	-.0060
RADIUS = .550								
AMPLITUDE =	-.1190	-.0243	.0166	.0015	.0180	-.0123	.0093	-.0116
RADIUS = .774								
AMPLITUDE =	-.1341	-.0370	-.0137	-.0003	.0057	-.0024	.0067	-.0060
RADIUS = 1.017								
AMPLITUDE =	-.1294	-.0445	-.0247	-.0070	-.0052	-.0005	-.0016	.0009
RADIUS = 1.178								
AMPLITUDE =	-.1354	-.0588	-.0282	-.0117	-.0074	-.0047	-.0038	-.0022

Table B5 - HARMONIC ANALYSIS OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	.0361	.0113	.0878	-.0330	-.0019	-.0014	-.0009	.0059
RADIUS = .300 AMPLITUDE =	-.0238	-.0005	.0651	-.0186	.0087	-.0078	.0038	-.0024
RADIUS = .400 AMPLITUDE =	-.0709	-.0109	.0445	-.0079	.0154	-.0116	.0071	-.0080
RADIUS = .500 AMPLITUDE =	-.1053	-.0199	.0260	-.0009	.0182	-.0128	.0089	-.0111
RADIUS = .600 AMPLITUDE =	-.1235	-.0270	.0089	.0014	.0153	-.0097	.0092	-.0105
RADIUS = .700 AMPLITUDE =	-.1310	-.0329	-.0056	.0008	.0096	-.0049	.0081	-.0080
RADIUS = .800 AMPLITUDE =	-.1328	-.0380	-.0152	-.0010	.0041	-.0017	.0055	-.0046
RADIUS = .900 AMPLITUDE =	-.1296	-.0423	-.0203	-.0037	-.0011	-.0002	.0017	-.0007
RADIUS = 1.000 AMPLITUDE =	-.1292	-.0475	-.0242	-.0065	-.0047	-.0003	-.0012	.0009

Table B6 - INPUT DATA FOR WAKE SURVEY ANALYSES
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN, DISPLACEMENT 26,390 TONS

RADIUS RATIO = 0.359

ANGLE	VX/V	VT/V	VR/V
-.2	.127	.001	0.000
1.0	.156	.040	-.005
1.7	.140	.012	-.005
9.0	.257	.031	.121
12.5	.262	.045	.100
19.6	.290	.037	.087
28.3	.332	.031	.069
39.1	.376	.023	.052
51.7	.422	-.012	.045
66.1	.510	-.060	.055
89.3	.728	-.047	.08[illegible]
120.2	.812	-.059	.124
150.6	.742	.040	.123
162.9	.677	.029	.069
169.5	.625	.040	.032
172.0	.542	.071	.007
175.8	.578	.054	-.002
179.4	.542	.029	-.013
181.4	.553	.032	-.023
184.6	.524	-.041	-.017
186.5	.548	-.051	-.007
192.0	.545	-.052	.004
195.7	.596	-.070	.034
211.5	.715	-.025	.120
240.2	.745	.052	.123
269.3	.728	.049	.091
276.5	.477	.065	.057
307.1	.412	.048	.044
319.7	.391	.017	.054
332.5	.276	-.005	.064
339.8	.243	.005	.080
344.7	.265	.011	.115
352.4	.272	.014	.130
355.9	.260	.022	.137
357.8	.274	.019	.133
359.4	.233	.028	.171
359.8	.127	.001	0.000

RADIUS RATIO = 0.556

ANGLE	VX/V	VT/V	VR/V
-.5	.137	-.002	-.003
3.3	.240	.001	.163
5.0	.280	-.018	.114
8.6	.313	-.005	.103
12.2	.341	-.007	.073
15.6	.336	-.014	.063
30.0	.497	-.059	.003
60.6	.810	-.147	-.034
89.4	.948	-.124	.003
114.9	.951	-.089	.050
127.6	.951	-.072	.065
140.1	.948	-.055	.083
152.8	.937	-.028	.104
160.0	.876	.010	.120
167.2	.756	.063	.090
172.3	.638	.084	.050
175.9	.564	.073	.002
177.7	.552	.052	-.017
179.4	.479	.035	-.024
181.3	.504	.001	-.027
183.1	.498	-.012	-.024
186.6	.550	-.045	.001
188.5	.611	-.055	.028
192.0	.642	-.055	.065
200.9	.848	-.000	.12[illegible]
208.1	.851	.037	.122
220.6	.869	.055	.100
231.4	.877	.081	.083
243.9	.907	.090	.054
269.5	.909	.120	.011
300.1	.772	.140	-.010
3[illegible]5	.447	.047	.014
343.1	.356	.030	.077
348.5	.315	.023	.112
352.3	.260	.019	.141
355.8	.145	.018	-.003
359.5	.137	-.002	-.003

RADIUS RATIO = 0.774

ANGLE	VX/V	VT/V	VR/V
-.4	.235	.015	.191
1.5	.234	-.006	.191
3.2	.251	-.016	.142
8.7	.283	-.019	.113
12.2	.315	-.035	.084
19.4	.427	-.075	.024
28.2	.532	-.101	-.011
40.8	.718	-.142	-.044
51.6	.828	-.149	-.053
64.2	.897	-.151	-.032
89.3	.930	-.122	.035
120.2	.930	-.065	.080
150.5	.932	-.051	.101
165.0	.933	-.031	.109
169.5	.941	-.013	.117
172.2	.914	.035	.131
175.9	.763	.045	.089
177.7	.683	.102	.052
181.3	.572	.024	-.007
183.2	.562	-.039	.00[illegible]
188.7	.742	-.062	.095
192.1	.891	-.031	.124
195.8	.940	.022	.123
210.1	.938	.053	.105
240.6	.932	.064	.084
269.6	.923	.112	.044
299.8	.905	.145	-.019
307.5	.851	.152	-.041
319.9	.730	.140	-.030
332.4	.572	.107	.005
339.6	.427	.070	.035
349.6	.327	.058	.082
352.0	.249	.027	.125
355.7	.281	.023	.144
357.4	.242	.009	.153
359.6	.235	.015	.191

CONTINUED

Table B6 - INPUT DATA FOR WAKE SURVEY ANALYSES
EXPERIMENT 2

TRIMMED 1.5 FEET BY THE STERN DISPLACEMENT 26,390 TONS

RADIUS RATIO = 1.017

ANGLE	VX/V	VT/V	VR/V
-.5	.276	-.009	.141
1.3	.279	-.015	.132
3.3	.306	-.041	.116
5.0	.334	-.045	.082
8.7	.365	-.059	.059
12.1	.438	-.070	.028
15.8	.470	-.048	.005
30.0	.671	-.139	-.070
60.6	.890	-.140	-.032
89.4	.930	-.109	.032
116.9	.932	-.075	.062
127.5	.934	-.062	.067
140.1	.938	-.049	.075
152.4	.938	-.036	.075
160.0	.936	-.029	.074
167.2	.936	-.023	.075
169.6	.939	-.020	.070
172.0	.932	-.019	.070
172.3	.935	-.019	.073
175.7	.945	-.006	.075
175.9	.948	-.005	.075
177.4	.921	.021	.091
177.7	.939	.015	.093
179.4	.904	.026	.114
179.6	.900	.024	.115
181.3	.893	.004	.114
181.5	.890	.005	.114
183.1	.934	-.009	.107
183.2	.919	-.014	.104
185.6	.938	.022	.074
188.5	.936	.027	.074
188.7	.932	.027	.075
192.0	.932	.029	.075
192.2	.933	.032	.077
199.4	.911	.034	.074
200.9	.929	.038	.074
208.1	.926	.045	.078
208.2	.929	.042	.078
220.6	.924	.055	.075
220.8	.927	.056	.075
231.4	.925	.058	.064
231.6	.928	.056	.069
243.9	.931	.080	.063
244.2	.929	.080	.062
269.3	.931	.107	.035
269.5	.930	.109	.037
300.1	.906	.144	-.030
300.2	.905	.145	-.030
330.5	.655	.135	-.044
330.5	.640	.137	-.047
343.1	.457	.094	.013
345.0	.444	.066	.027
348.5	.387	.056	.054
348.5	.387	.052	.052
352.2	.335	.045	.090
352.3	.333	.048	.099
355.8	.269	.029	.135
357.7	[illegible]	.022	.124
359.5	.276	-.009	.141

RADIUS RATIO = 1.178

ANGLE	VX/V	VT/V	VR/V
-.2	.246	.015	.140
1.0	.205	-.017	.135
1.7	.225	-.009	.125
3.6	.263	-.022	.117
9.0	.349	-.073	.044
12.5	.402	-.089	.024
19.6	.498	-.123	-.014
28.3	.623	-.148	-.057
39.1	.729	-.158	-.065
51.7	.794	-.157	-.035
64.1	.841	-.148	.010
89.3	.867	-.111	.058
120.2	.875	-.068	.085
150.6	.887	-.032	.097
162.9	.890	-.018	.095
168.5	.894	-.013	.094
172.0	.898	-.005	.091
175.8	.890	.003	.08[illegible]
179.4	.891	.006	.087
181.4	.896	.010	.085
184.6	.899	.015	.089
188.5	.901	.017	.090
192.0	.901	.023	.092
195.7	.899	.026	.093
211.5	.900	.044	.094
240.2	.888	.075	.080
269.3	.882	.112	.053
296.5	.869	.155	.005
307.1	.839	.165	-.027
319.7	.754	.169	-.061
332.5	.612	.157	-.044
339.8	.570	.134	-.025
348.7	.388	.100	.042
352.4	.295	.087	.065
355.9	.251	.065	.104
357.8	.229	.077	.115
359.4	.201	.040	.132
359.8	.246	.015	.140

APPENDIX C

RESULTS OF EXPERIMENT 3

Corresponding to

Trim 1.0 ft (0.305 m) by the Bow

Displacement 26,390 Tons (26,810 tonnes)

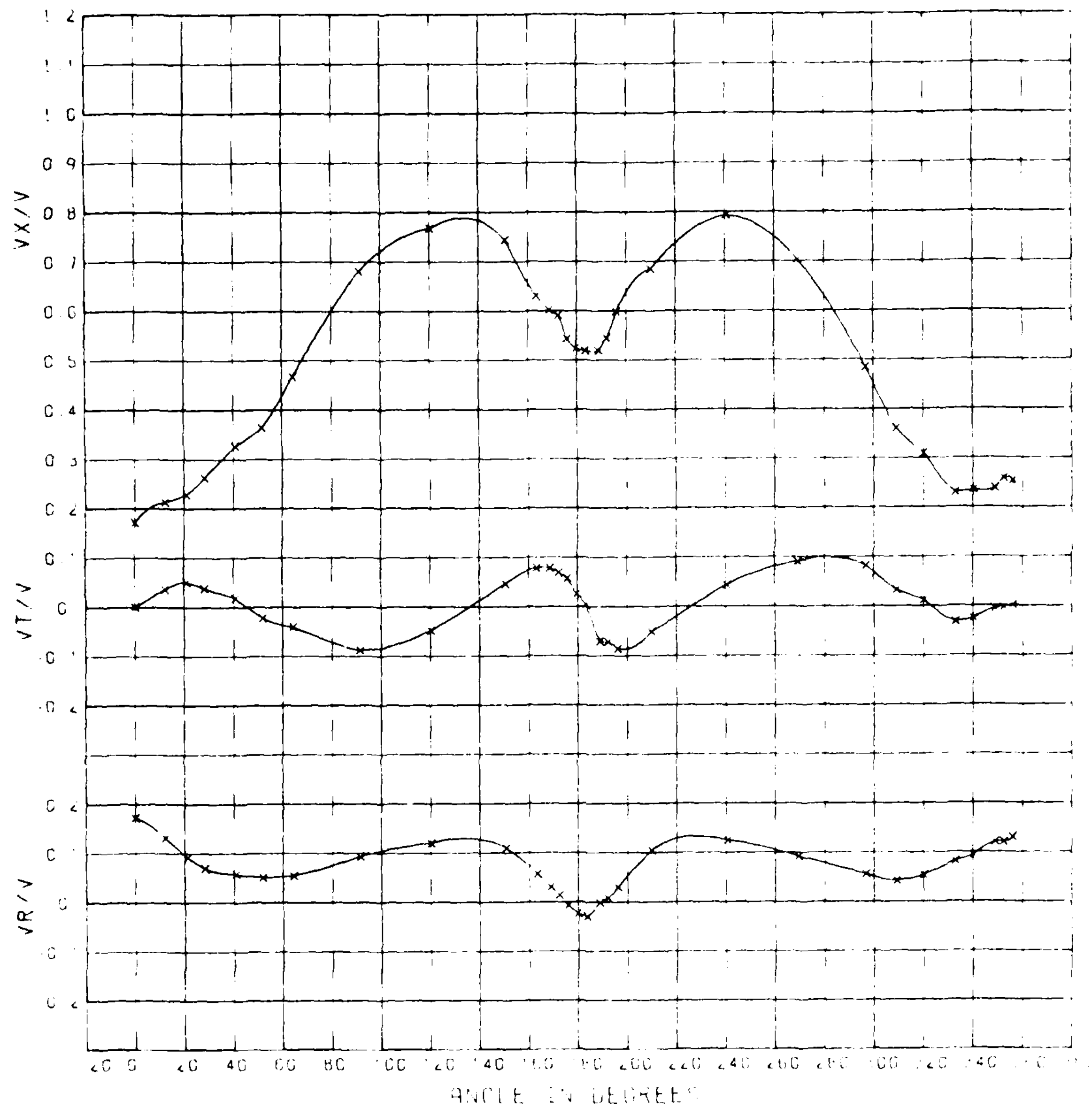


Figure C1 – CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS – RADIUS RATIO = 0.359
EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW, DISPLACEMENT 26,300 TONS

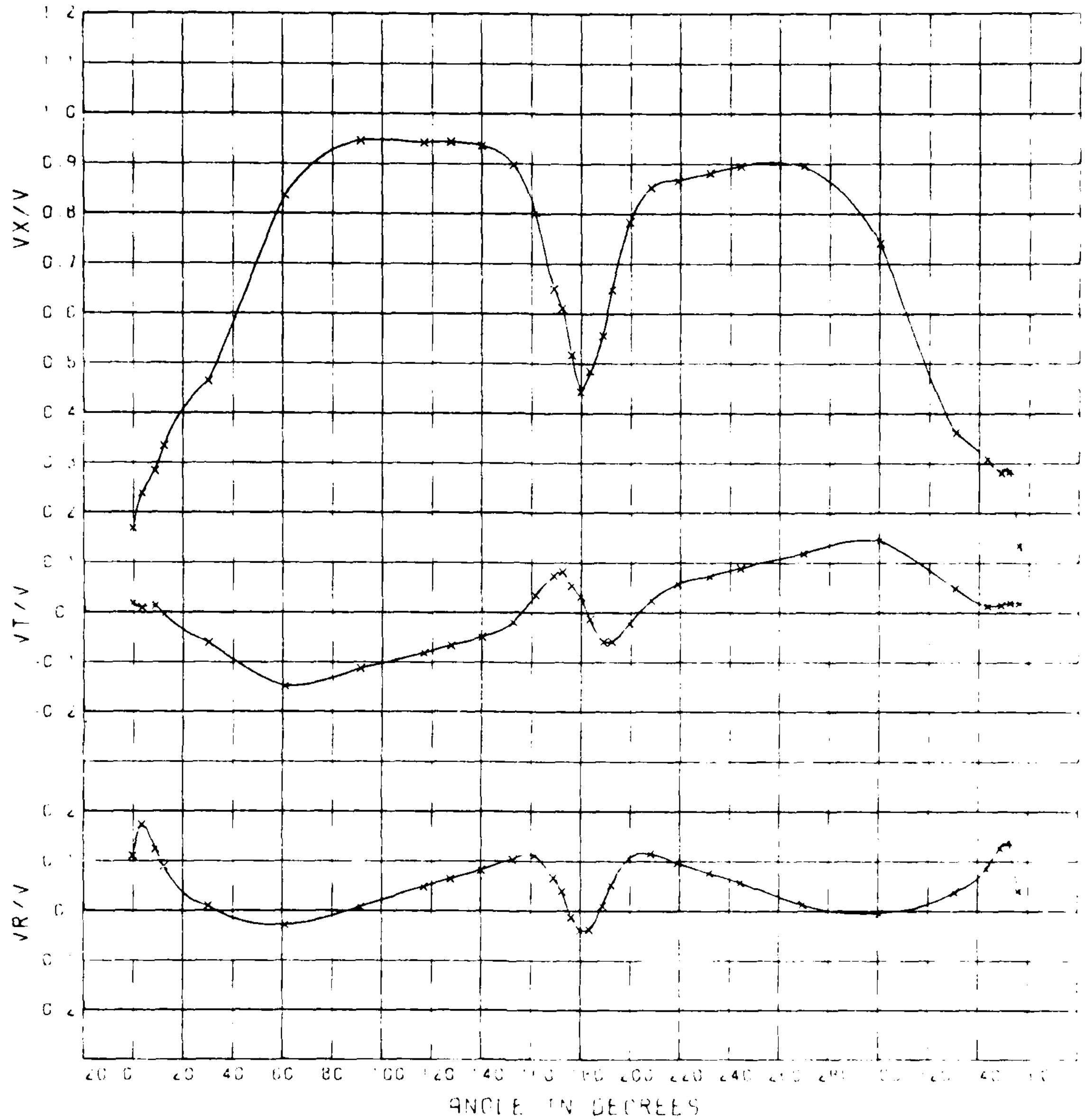


Figure C2 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.556
EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW, DISPLACEMENT 26,390 TONS

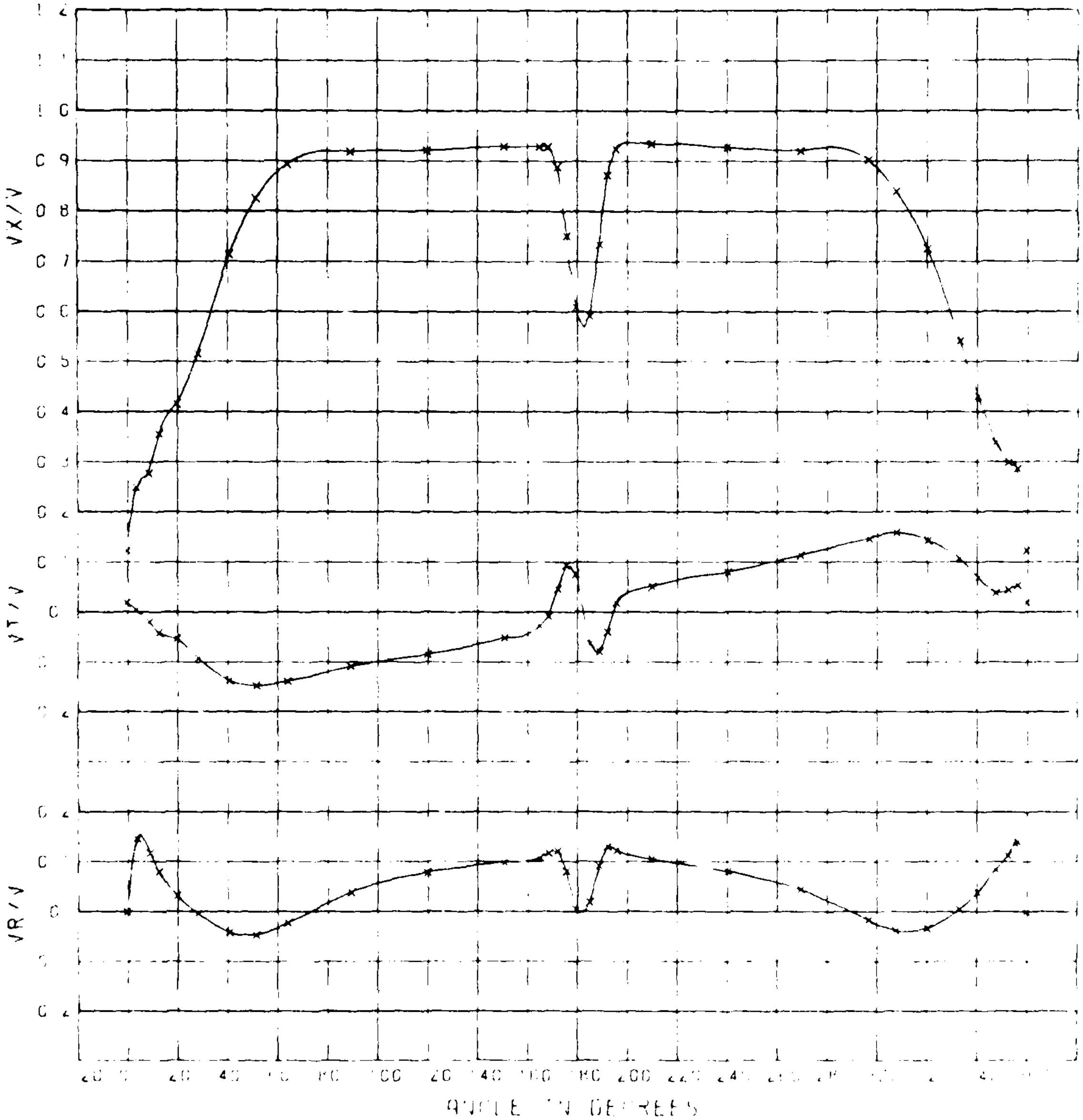


Figure C3 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.774
EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW, DISPLACEMENT 26,[illegible]90 TONS

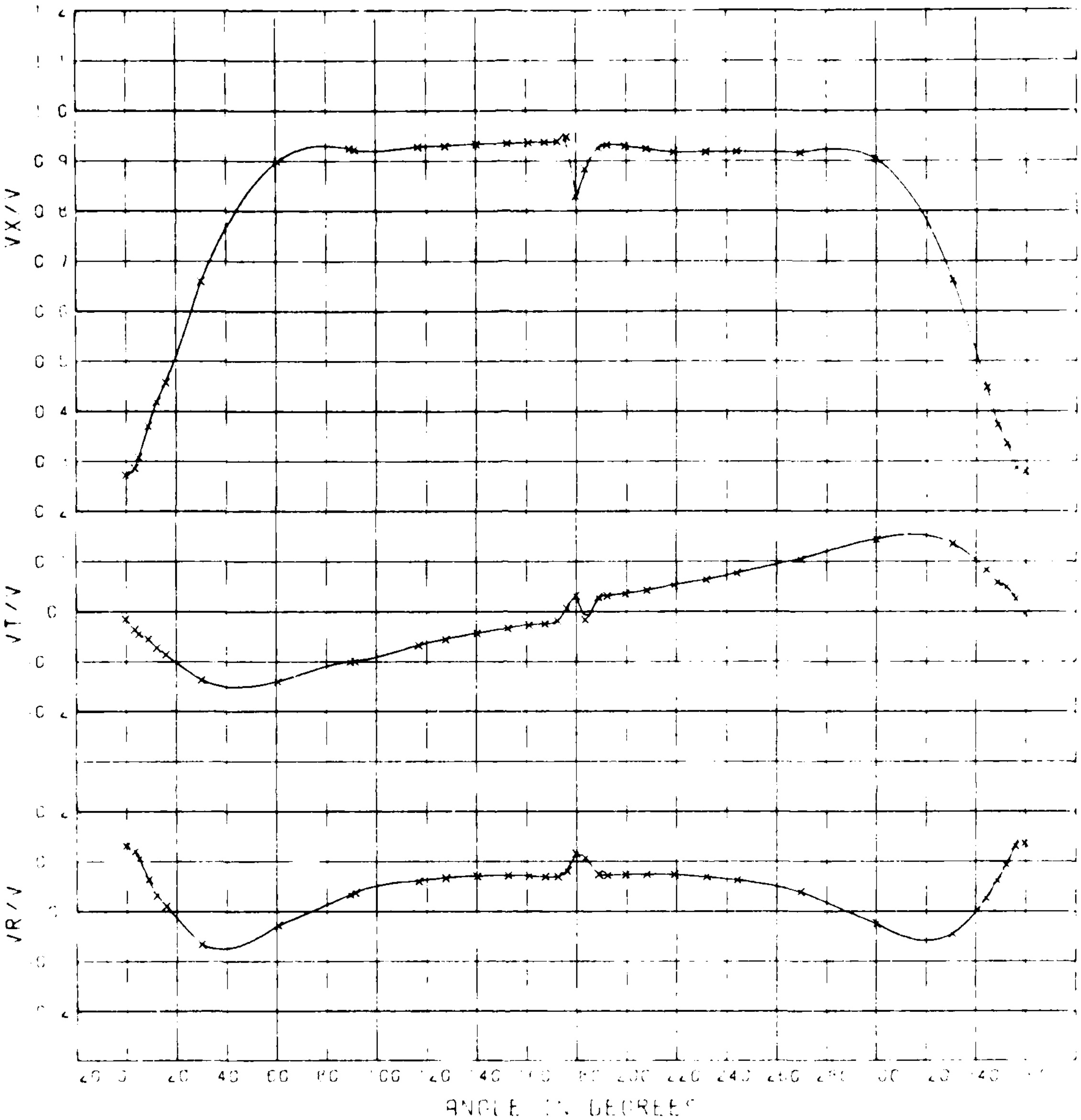


Figure C4 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 1.017
EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW, DISPLACEMENT 26,390 TONS

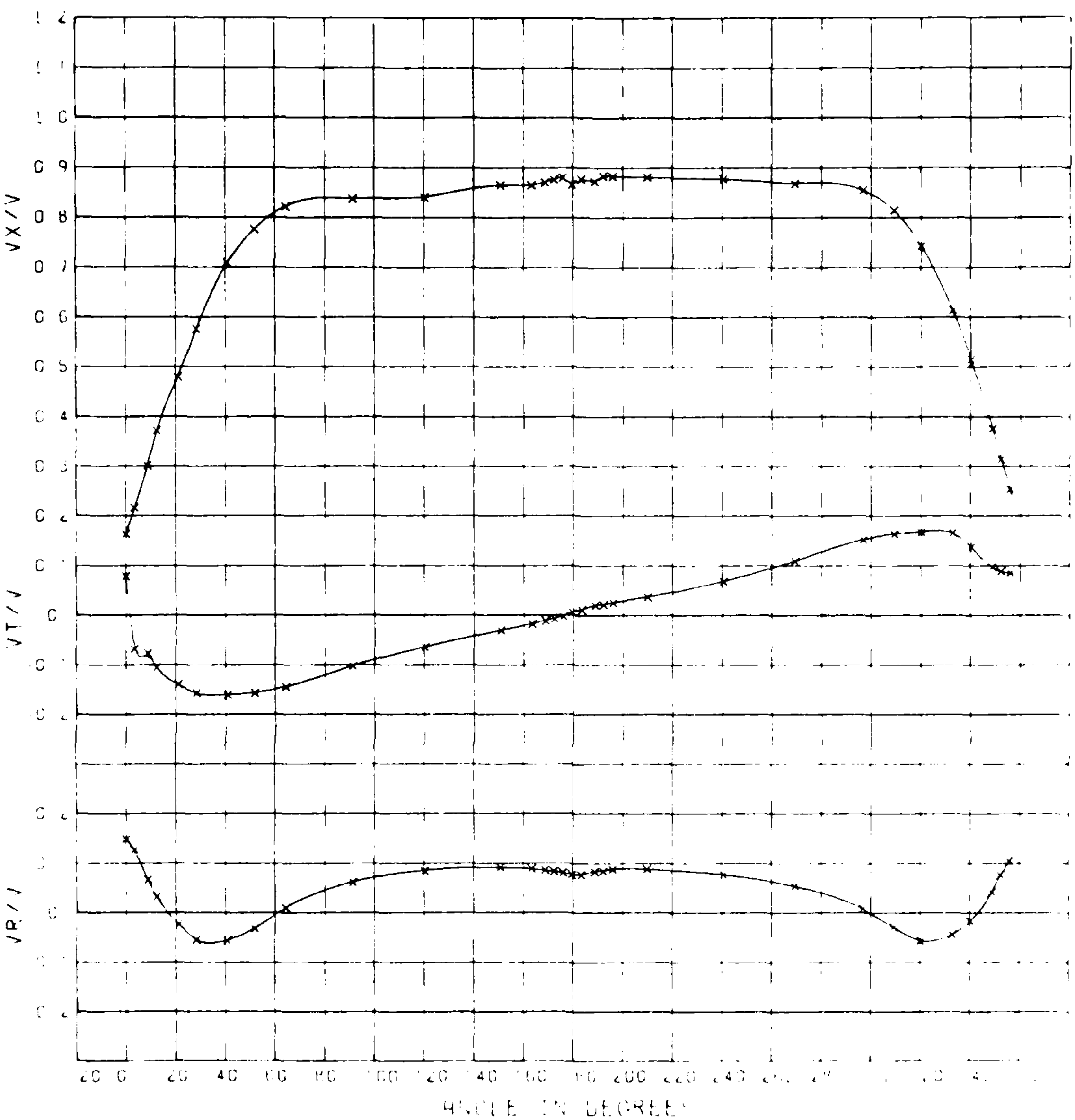


Figure C5 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 1.178
EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW, DISPLACEMENT 26,390 TONS

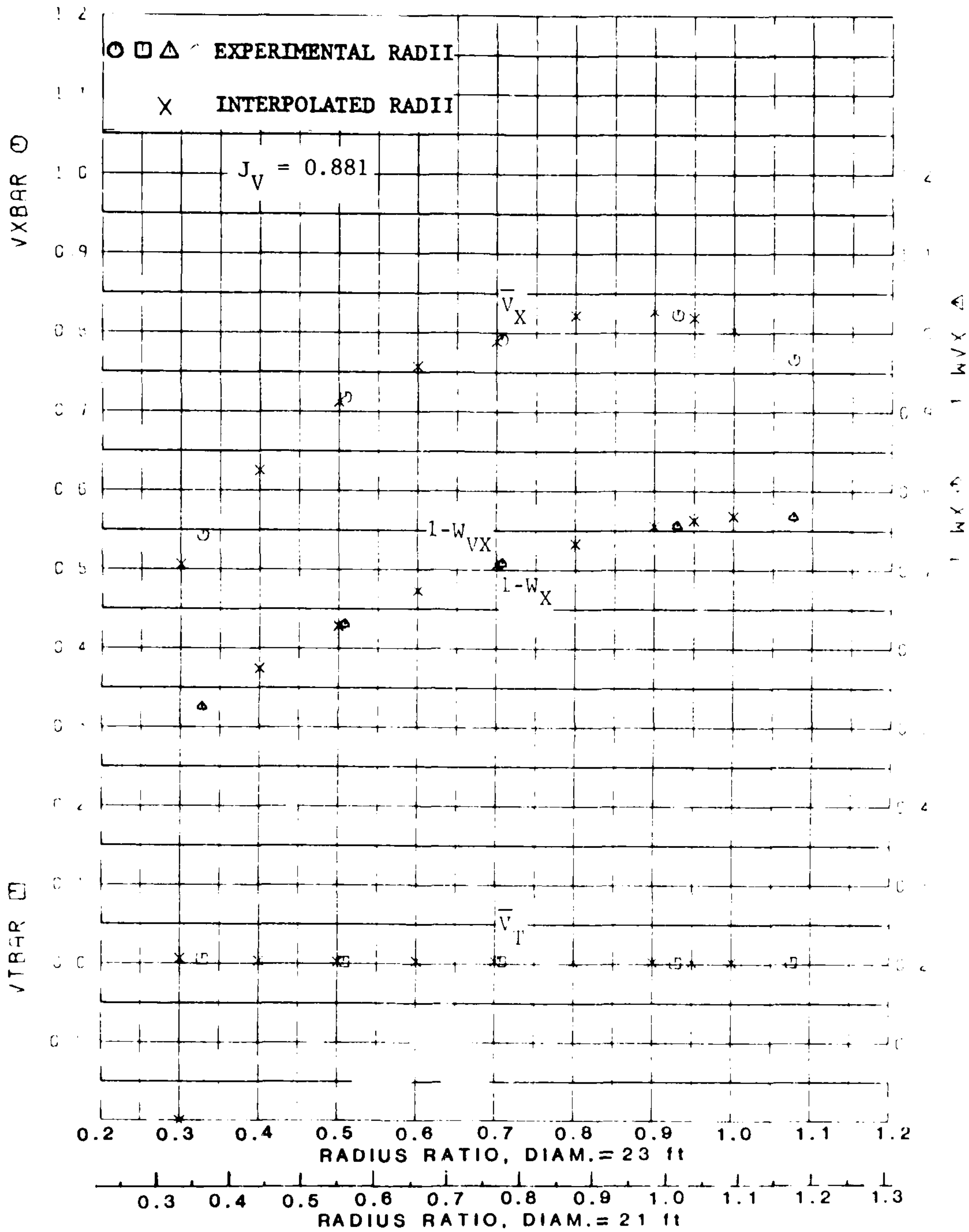


Figure C6 - RADIAL DISTRIBUTION OF THE MEAN VELOCITY COMPONENT RATIOS
EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW, DISPLACEMENT 26,390 TONS

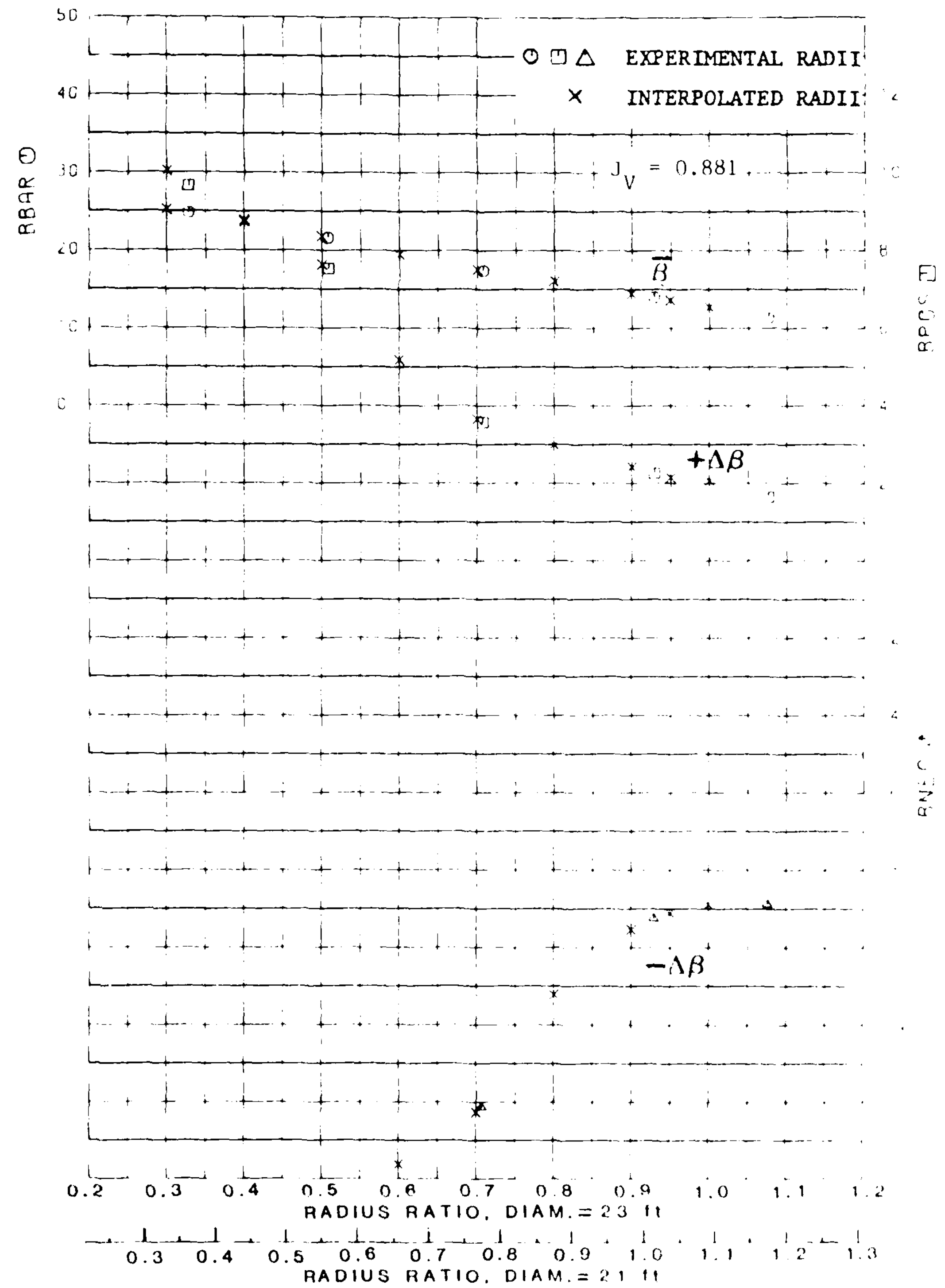


Figure C7 - RADIAL DISTRIBUTION OF THE MEAN ADVANCE ANGLE AND THE MAXIMUM VARIATIONS OF THE ADVANCE ANGLE FOR MODEL [illegible]
EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW, DISPLACEMENT 26,390 TONS

Table C1 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES
EXPERIMENT 3

TRIMMED 1.0 FEET BY THE BOW, DISPLACEMENT 26,390 TONS
D = 21 ft (6.4 m), $J_V = 1.01$

RADIUS =	.359	.556	.774	1.017	1.178	.200	.300	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	.543	.718	.791	.823	.767	.327	.470	.588	.678	.736	.771	.801	.825	.826
VTBAR =	.005	.002	.003	.002	.003	.011	.007	.004	.002	.002	.003	.003	.002	.002
VRBAR =	.085	.040	.040	.030	.043	.155	.107	.072	.048	.043	.046	.043	.033	.032
1-WVX =	.466	.579	.674	.734	.751	0.000	.413	.481	.547	.603	.647	.682	.711	.734
1-WX =	.470	.581	.676	.735	.752	0.000	.418	.482	.548	.605	.649	.683	.712	.735
BBAR =	25.82	22.51	18.17	14.58	11.82	27.30	26.58	25.21	23.53	21.50	19.48	17.83	16.42	14.85
BPOS =	5.94	7.83	3.75	2.37	1.71	23.05	12.02	9.49	8.43	6.65	4.68	3.59	3.00	2.45
THETA =	115.00	90.00	77.50	77.50	175.00	225.00	230.00	112.50	100.00	92.50	82.50	77.50	77.50	77.50
BNEG =	-17.04	-18.94	-14.76	-9.67	-9.30	-38.10	-18.84	-17.19	-19.12	-17.18	-15.83	-13.83	-11.21	-9.81
THETA =	0.00	357.50	0.00	0.00	0.00	57.50	20.00	0.00	357.50	357.50	0.00	0.00	0.00	0.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

Table C2 - HARMONIC ANALYSIS OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359								
AMPLITUDE =	.2408	.1450	.0613	.0136	.0188	.0132	.0081	.0048
PHASE ANGLE =	269.0	267.4	75.5	240.2	85.7	251.9	142.9	211.6
RADIUS = .556								
AMPLITUDE =	.2077	.2387	.0187	.0537	.0450	.0322	.0196	.0289
PHASE ANGLE =	281.8	272.7	348.8	271.3	88.2	272.6	88.6	267.9
RADIUS = .774								
AMPLITUDE =	.1975	.1865	.0730	.0721	.0107	.0295	.0212	.0249
PHASE ANGLE =	268.6	268.7	268.4	266.4	69.9	260.4	69.4	259.7
RADIUS = 1.017								
AMPLITUDE =	.1834	.1425	.0932	.0543	.0221	.0164	.0071	.0103
PHASE ANGLE =	270.7	268.0	270.4	269.6	276.8	279.6	288.2	272.0
RADIUS = 1.178								
AMPLITUDE =	.1869	.1275	.0907	.0530	.0286	.0191	.0136	.0106
PHASE ANGLE =	263.2	268.0	266.2	265.6	267.1	268.8	262.9	269.0

Table C3 - HARMONIC ANALYSIS OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII

EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200								
AMPLITUDE =	.3111	.0510	.1104	.0454	.0427	.0250	.0211	.0412
PHASE ANGLE =	250.5	146.6	91.1	119.3	273.8	130.9	233.8	105.0
RADIUS = .300								
AMPLITUDE =	.2603	.0925	.0789	.0128	.0018	.0082	.0089	.0126
PHASE ANGLE =	262.3	259.0	82.4	154.8	3.8	197.6	194.3	118.9
RADIUS = .400								
AMPLITUDE =	.2308	.1754	.0495	.0229	.0287	.0185	.0104	.0108
PHASE ANGLE =	273.1	269.9	69.1	259.7	87.5	263.6	115.6	254.1
RADIUS = .500								
AMPLITUDE =	.2142	.2256	.0242	.0442	.0432	.0288	.0169	.0244
PHASE ANGLE =	280.1	272.3	36.0	270.2	88.4	271.9	94.8	266.9
RADIUS = .600								
AMPLITUDE =	.2047	.2271	.0249	.0600	.0376	.0322	.0217	.0288
PHASE ANGLE =	278.1	271.7	300.1	269.4	86.8	258.5	82.6	265.4
RADIUS = .700								
AMPLITUDE =	.2002	.2028	.0549	.0695	.0215	.0313	.0232	.0272
PHASE ANGLE =	271.6	269.8	272.5	267.1	81.3	262.4	74.2	261.3
RADIUS = .800								
AMPLITUDE =	.1954	.1806	.0765	.0693	.0066	.0269	.0175	.0224
PHASE ANGLE =	269.5	268.6	269.2	267.1	54.4	262.8	66.7	260.8
RADIUS = .900								
AMPLITUDE =	.1889	.1605	.0871	.0605	.0105	.0198	.0060	.0159
PHASE ANGLE =	271.6	268.3	270.8	269.1	291.7	272.7	36.8	265.8
RADIUS = 1.000								
AMPLITUDE =	.1840	.1448	.0928	.0550	.0207	.0166	.0061	.0107
PHASE ANGLE =	271.0	268.1	270.6	269.7	278.0	279.3	295.3	271.3

Table C4 - HARMONIC ANALYSIS OF TANGENTIAL VELOCITY COMPONENT RATIOS
AT THE EXPERIMENTAL RADII
EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359								
AMPLITUDE =	.0442	.0133	.0591	.0091	.0184	.0089	.0078	.0057
PHASE ANGLE =	170.8	178.4	353.3	164.7	2.9	158.2	328.4	176.4
RADIUS = .556								
AMPLITUDE =	.1162	.0297	.0181	.0046	.0215	.0115	.0106	.0108
PHASE ANGLE =	181.7	174.9	3.4	71.1	2.5	158.9	1.9	161.0
RADIUS = .774								
AMPLITUDE =	.1305	.0366	.0145	.0025	.0086	.0016	.0079	.0072
PHASE ANGLE =	178.2	174.8	183.3	75.5	1.2	112.9	359.3	156.4
RADIUS = 1.017								
AMPLITUDE =	.1248	.0488	.0248	.0061	.0040	.0014	.0016	.0002
PHASE ANGLE =	181.3	181.3	182.4	187.4	177.1	348.6	222.9	219.0
RADIUS = 1.178								
AMPLITUDE =	.1324	.0627	.0312	.0142	.0104	.0064	.0054	.0033
PHASE ANGLE =	173.7	178.4	179.9	174.0	175.5	169.2	166.9	150.4

Table C5 - HARMONIC ANALYSIS OF TANGENTIAL VELOCITY COMPONENT RATIOS
AT THE INTERPOLATED RADII
EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200								
AMPLITUDE =	.0630	.0146	.1013	.0248	.0058	.0019	.0110	.0058
PHASE ANGLE =	26.2	349.0	348.5	184.1	4.1	10.7	265.4	304.6
RADIUS = .300								
AMPLITUDE =	.0173	.0022	.0738	.0140	.0148	.0058	.0076	.0032
PHASE ANGLE =	128.6	199.5	351.3	175.4	3.0	155.3	304.3	203.5
RADIUS = .400								
AMPLITUDE =	.0635	.0153	.0496	.0066	.0202	.0103	.0084	.0074
PHASE ANGLE =	176.8	176.6	354.8	151.8	2.8	158.9	340.7	169.8
RADIUS = .500								
AMPLITUDE =	.1014	.0254	.0286	.0042	.0220	.0119	.0101	.0101
PHASE ANGLE =	181.2	175.2	359.5	95.0	2.6	159.3	357.5	162.9
RADIUS = .600								
AMPLITUDE =	.1203	.0308	.0098	.0044	.0187	.0088	.0105	.0103
PHASE ANGLE =	180.5	174.2	3.3	67.1	2.3	156.4	1.6	159.8
RADIUS = .700								
AMPLITUDE =	.1272	.0338	.0059	.0035	.0128	.0039	.0094	.0087
PHASE ANGLE =	178.7	173.9	183.6	65.3	1.6	144.5	.7	157.6
RADIUS = .800								
AMPLITUDE =	.1284	.0373	.0156	.0017	.0070	.0011	.0068	.0058
PHASE ANGLE =	178.9	176.4	183.5	82.1	1.1	70.3	356.1	157.2
RADIUS = .900								
AMPLITUDE =	.1248	.0416	.0199	.0020	.0016	.0025	.0030	.0018
PHASE ANGLE =	180.6	180.4	183.5	186.4	2.1	359.2	334.5	164.7
RADIUS = 1.000								
AMPLITUDE =	.1245	.0476	.0241	.0054	.0033	.0018	.0014	.0003
PHASE ANGLE =	181.3	181.3	182.6	188.6	177.1	350.0	240.9	215.1

Table C6 - INPUT DATA FOR WAKE SURVEY ANALYSES
EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW, DISPLACEMENT 26,390 TONS

RADIUS RATIO = 0.359

ANGLE	VX/V	VT/V	VR/V
-.1	.172	.001	.172
12.2	.213	.035	.131
21.0	.224	.051	.092
28.2	.262	.039	.069
40.8	.326	.018	.054
51.7	.364	-.023	.051
66.1	.458	-.040	.052
68.2	.467	-.041	.055
91.1	.687	-.045	.095
91.6	.676	-.043	.090
120.2	.767	-.048	.119
150.7	.744	.046	.113
163.3	.631	.078	.057
168.7	.602	.078	.030
172.3	.540	.069	.014
175.9	.543	.057	-.007
179.5	.524	.025	-.024
183.1	.519	.003	-.030
188.7	.520	-.021	-.002
192.1	.544	-.073	.007
195.9	.549	-.045	.030
209.8	.645	-.051	.103
242.5	.733	.043	.125
263.3	.703	.040	.042
296.8	.485	.042	.055
303.2	.360	.032	.042
320.0	.310	.012	.053
332.7	.240	-.033	.081
340.1	.235	-.025	.093
344.8	.238	-.006	.120
352.3	.258	-.004	.120
356.0	.254	.001	.124
359.9	.172	.001	.172

RADIUS RATIO = 0.556

ANGLE	VX/V	VT/V	VR/V
-.3	.168	.019	.110
3.3	.239	.009	.173
8.7	.283	.013	.125
12.2	.334	-.005	.063
30.1	.464	-.061	.010
60.7	.836	-.149	-.024
91.3	.946	-.114	.007
116.7	.943	-.083	.044
127.5	.944	-.067	.064
140.0	.936	-.050	.081
152.5	.900	-.018	.103
152.8	.895	-.024	.106
161.6	.803	.034	.112
168.9	.649	.073	.067
172.4	.611	.062	.034
176.1	.517	.054	-.013
179.7	.443	.032	-.040
183.4	.485	-.014	-.037
188.8	.555	-.060	.010
192.2	.648	-.059	.051
199.5	.783	-.022	.105
208.1	.852	.026	.115
219.0	.866	.057	.095
231.8	.881	.073	.075
244.1	.900	.085	.055
244.2	.890	.089	.054
269.5	.900	.119	.012
269.5	.890	.118	.013
300.2	.742	.145	-.005
330.6	.361	.049	.035
343.4	.309	.013	.085
348.7	.279	.014	.125
352.3	.244	.019	.134
356.1	.134	.019	.034
359.7	.168	.018	.110

RADIUS RATIO = 0.774

ANGLE	VX/V	VT/V	VR/V
-.4	.122	.018	-.001
3.3	.249	.004	.145
8.5	.276	-.021	.117
12.3	.356	-.042	.074
19.5	.416	-.054	.031
28.0	.515	-.042	-.004
40.6	.713	-.138	-.042
51.4	.826	-.148	-.047
63.9	.893	-.140	-.023
89.1	.918	-.110	.035
119.8	.920	-.065	.077
150.6	.929	-.052	.094
164.8	.928	-.028	.107
168.3	.928	-.009	.115
172.0	.888	.047	.121
175.6	.751	.046	.080
179.3	.608	.075	.004
184.9	.591	-.064	.014
188.7	.734	-.080	.091
191.9	.871	-.039	.130
195.5	.924	.019	.122
209.7	.934	.050	.105
240.2	.927	.079	.080
269.4	.919	.113	.044
295.7	.902	.145	-.017
307.6	.839	.159	-.034
320.2	.726	.143	-.034
332.9	.540	.105	.004
340.2	.430	.069	.035
347.3	.338	.037	.083
352.4	.244	.044	.111
356.0	.246	.054	.140
359.6	.122	.018	-.001

CONTINUED

Table C6 - INPUT DATA FOR WAKE SURVEY ANALYSES
EXPERIMENT 3

TRIMMED 1.0 FOOT BY THE BOW, DISPLACEMENT 26,390 TONS

RADIUS RATIO = 1.017

ANGLE	VX/V	VT/V	VR/V
-.3	.272	-.016	.131
3.3	.285	-.036	.120
4.9	.307	-.045	.105
9.7	.375	-.055	.057
8.7	.365	-.057	.068
11.9	.422	-.065	.035
12.2	.415	-.079	.027
15.5	.445	-.080	.015
16.0	.469	-.093	.005
29.7	.654	-.134	-.064
30.1	.666	-.140	-.069
60.2	.899	-.140	-.029
60.7	.897	-.142	-.028
80.6	.925	-.101	.033
91.3	.922	-.100	.037
116.7	.931	-.067	.059
116.7	.924	-.070	.061
127.5	.928	-.057	.068
127.6	.930	-.055	.064
140.0	.932	-.045	.071
140.2	.933	-.043	.068
152.5	.934	-.034	.072
160.2	.939	-.028	.070
161.6	.933	-.026	.072
167.3	.937	-.025	.069
172.4	.941	-.019	.065
172.4	.936	-.019	.072
174.0	.951	.003	.078
174.1	.944	.007	.082
179.6	.844	.041	.117
179.7	.814	.022	.115
183.3	.894	-.015	.107
183.4	.873	-.019	.105
188.5	.930	.028	.073
188.8	.921	.028	.073
192.2	.925	.032	.075
192.3	.939	.040	.069
199.5	.922	.045	.075
199.5	.937	.045	.071
208.0	.925	.042	.073
208.1	.923	.042	.075
219.0	.917	.053	.073
231.8	.917	.063	.064
244.1	.918	.075	.063
269.5	.915	.124	.034
299.8	[illegible]	.143	[illegible]
300.2	.903	.143	-.124
331.6	.655	.142	-.047
330.6	.569	.124	-.044
343.4	.462	[illegible]	.021
344.8	.432	.065	.030
348.3	.341	.065	.064
348.7	.365	.061	.354
352.0	.333	[illegible]	[illegible]
352.3	.337	.047	.091
355.6	.241	.025	.134
356.1	.241	.024	.125
359.3	.256	.017	.141
359.7	.272	-.015	.131

RADIUS RATIO = 1.178

ANGLE	VX/V	VT/V	VR/V
-.1	.163	.078	.148
3.3	.216	-.068	.125
8.7	.301	-.077	.065
12.2	.372	-.106	.031
21.0	.479	-.140	-.024
28.2	.576	-.158	-.057
40.8	.709	-.161	-.055
51.7	.776	-.158	-.032
64.1	.827	-.144	.009
64.2	.815	-.147	.010
91.1	.837	-.103	.061
91.4	.837	-.104	.061
120.2	.840	-.065	.084
150.7	.865	-.031	.091
163.3	.865	-.018	.089
168.7	.870	-.012	.086
172.3	.876	-.008	.083
175.9	.881	-.003	.080
179.5	.866	.005	.077
183.3	.877	.011	.075
188.7	.872	.020	.083
192.1	.884	.021	.084
195.9	.883	.025	.087
209.8	.881	.037	.087
240.5	.878	.068	.077
269.3	.868	.108	.054
295.8	.855	.152	.005
309.2	.814	.163	-.024
320.0	.743	.167	-.056
332.7	.614	.166	-.045
340.1	.515	.137	-.017
348.8	.376	.097	.041
352.3	.314	.088	.075
356.0	.254	.085	.104
359.9	.163	.078	.148

APPENDIX D

RESULTS OF EXPERIMENT 4

Corresponding to

Trim 3.5 ft (1.067 m) by the Bow

Displacement 26,390 Tons (26,810 tonnes)

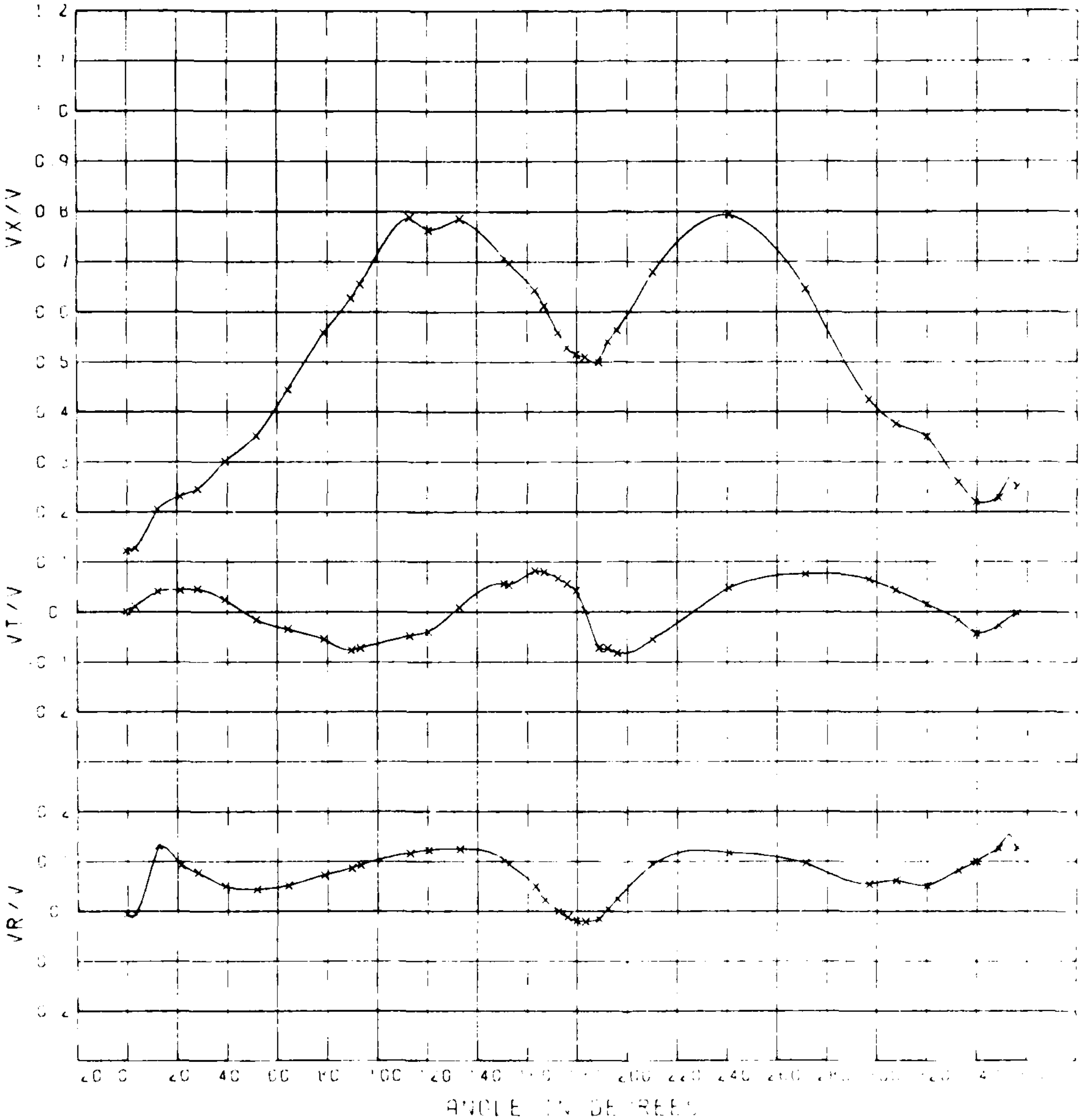


Figure D1 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.359
EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS

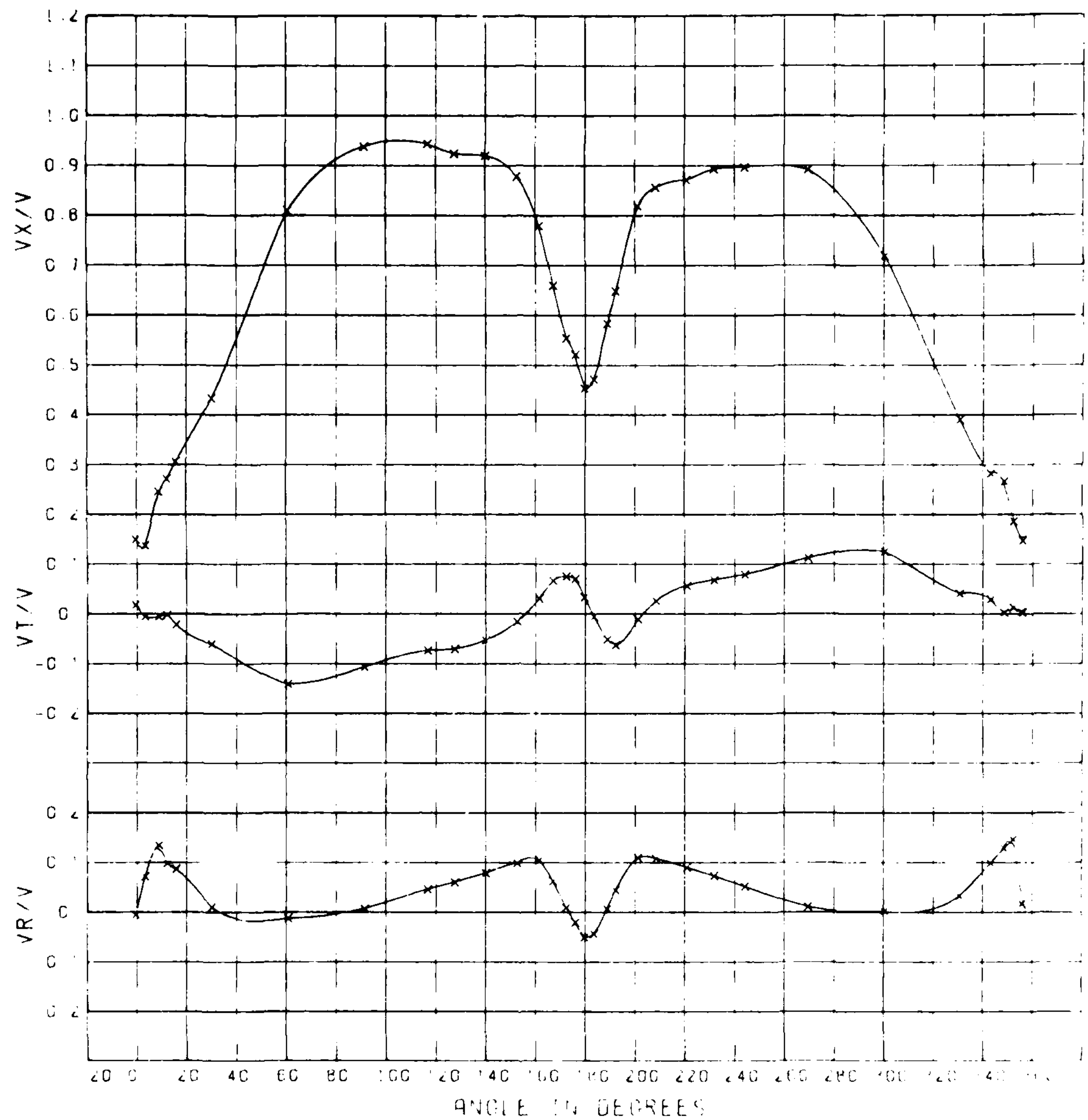


Figure D2 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.556
EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS

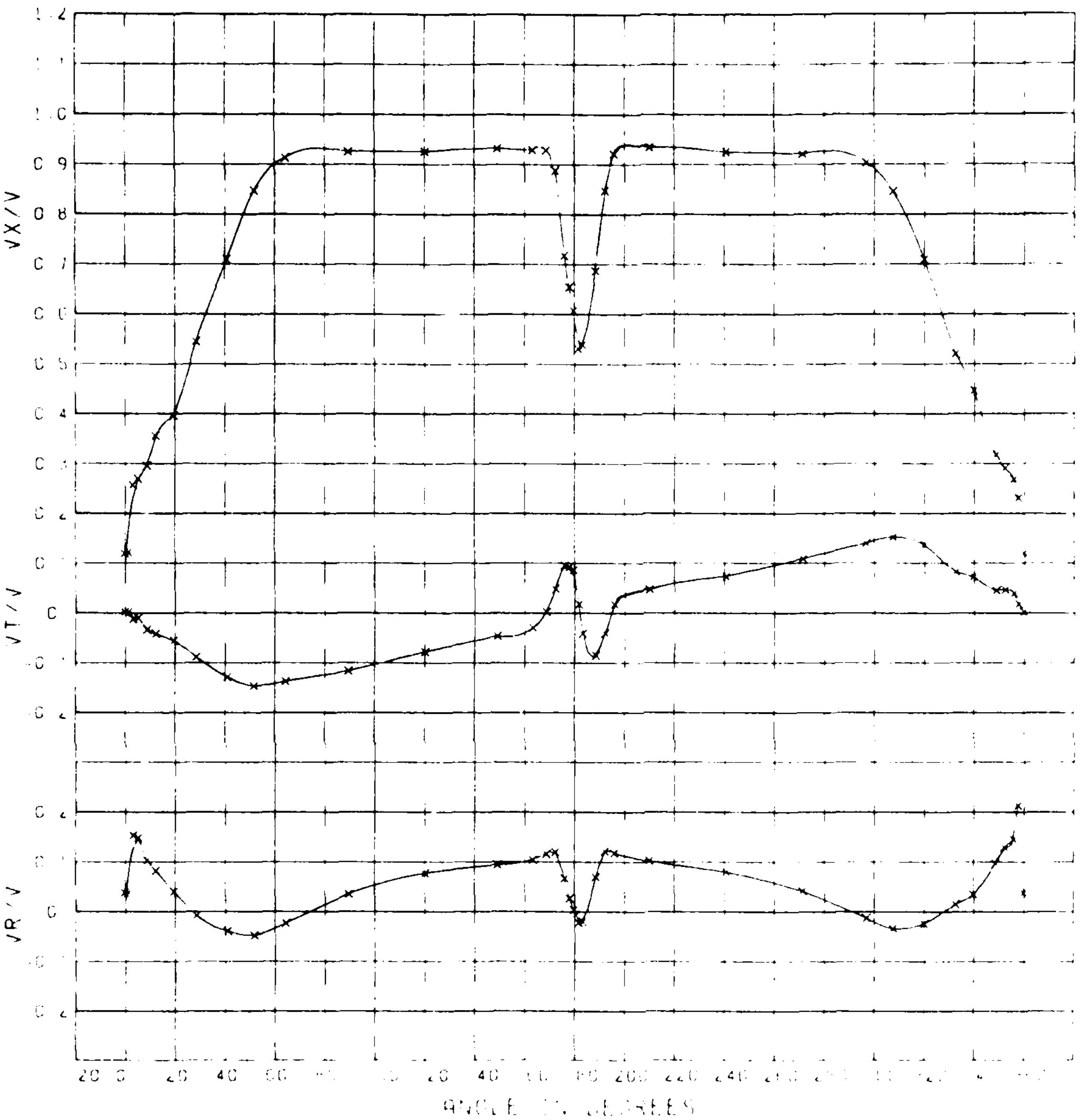


Figure D3 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 0.774
EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS

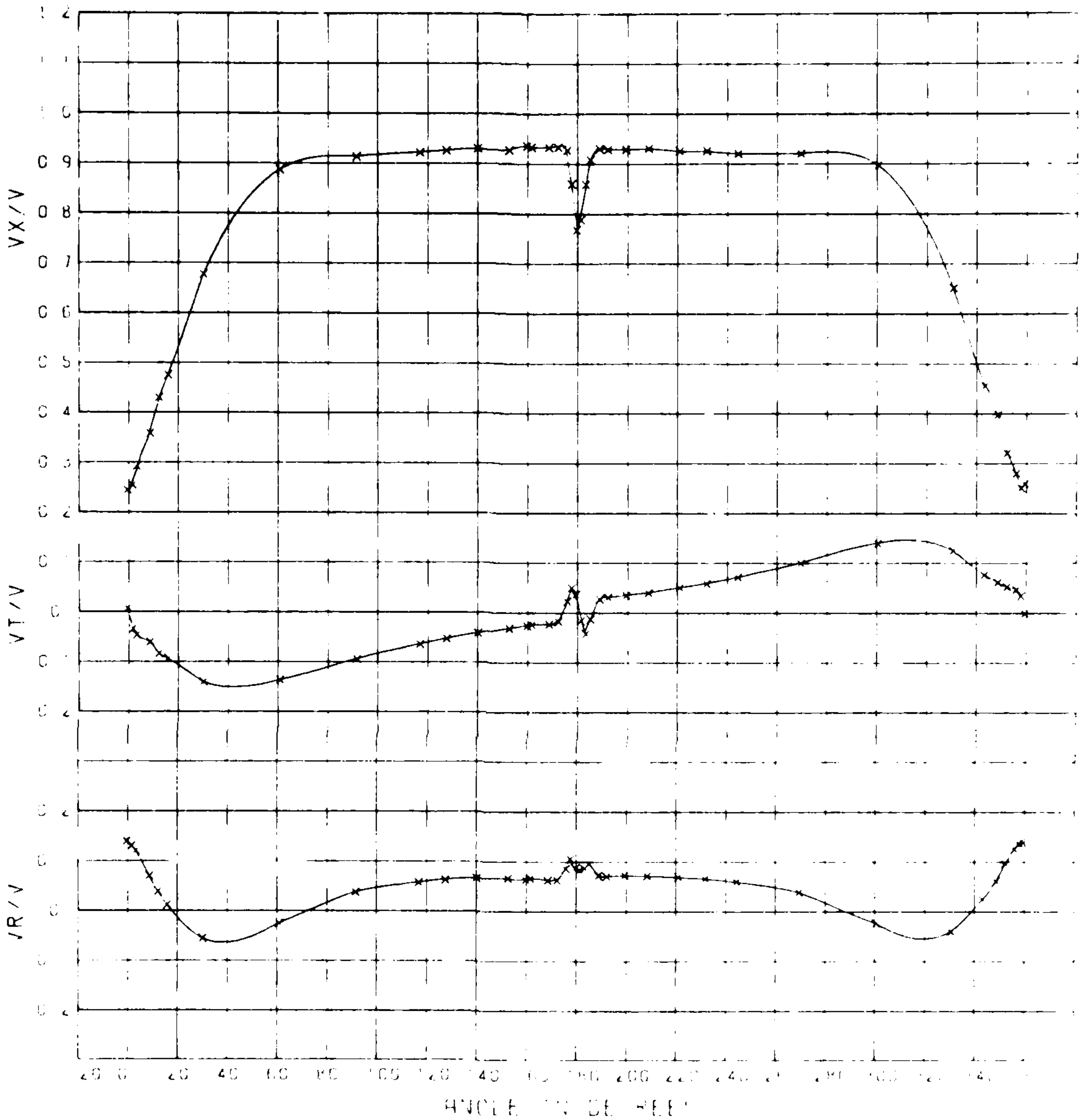


Figure D4 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 1.017
EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS

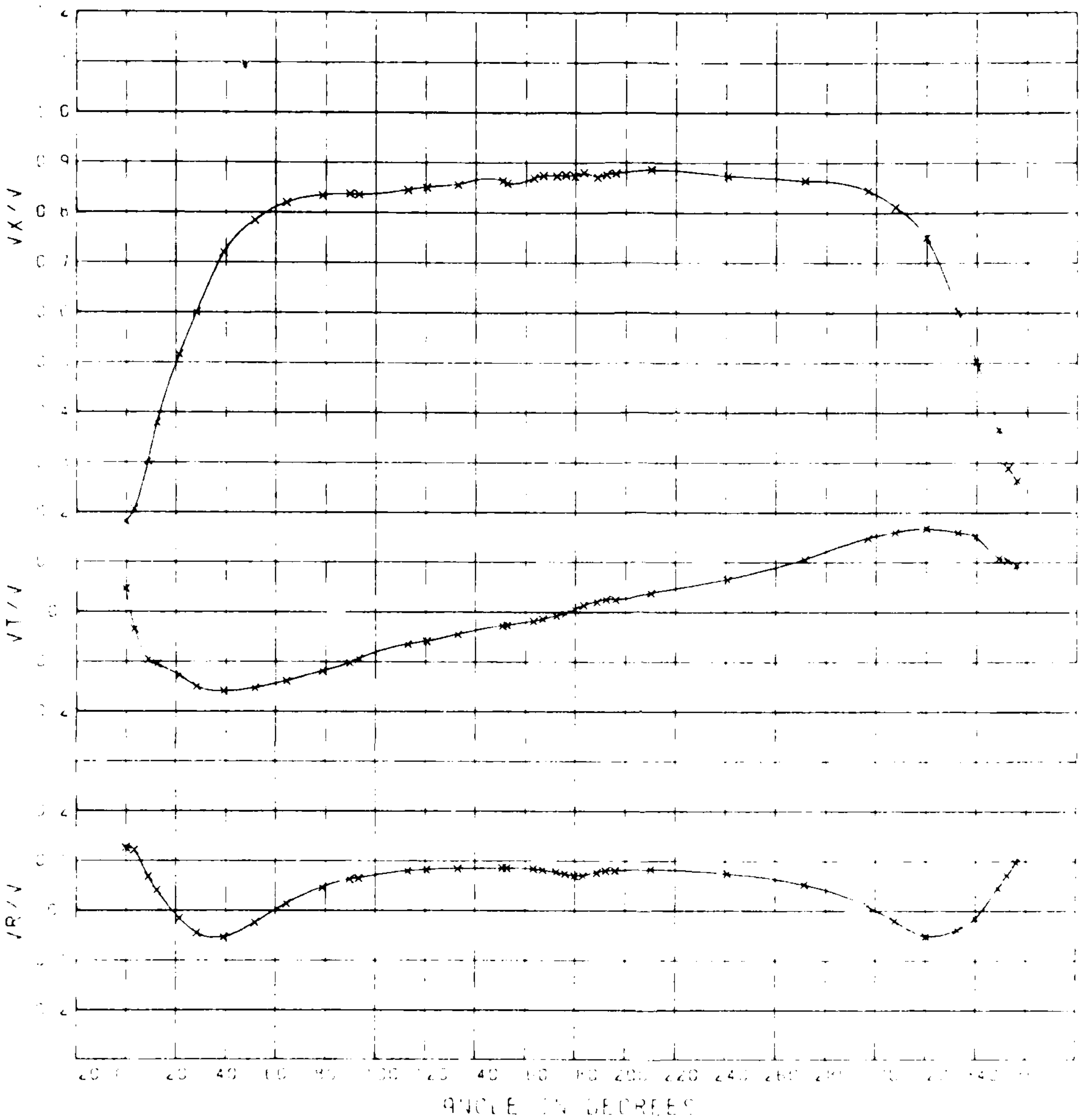


Figure D5 - CIRCUMFERENTIAL DISTRIBUTION OF THE LONGITUDINAL, TANGENTIAL AND RADIAL VELOCITY COMPONENT RATIOS - RADIUS RATIO = 1.178
EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS

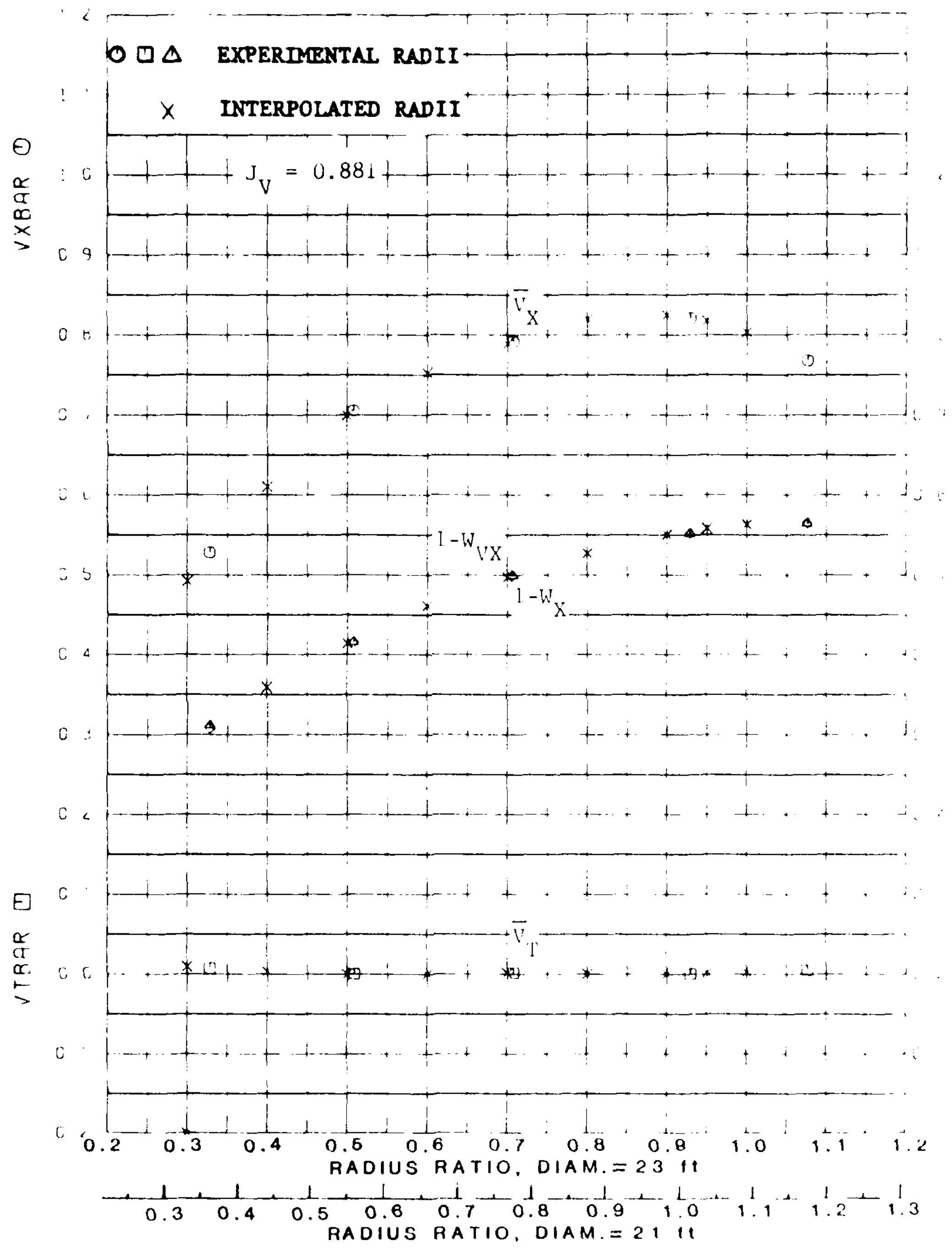


Figure D6 - RADIAL DISTRIBUTION OF THE MEAN VELOCITY COMPONENT RATIOS EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS

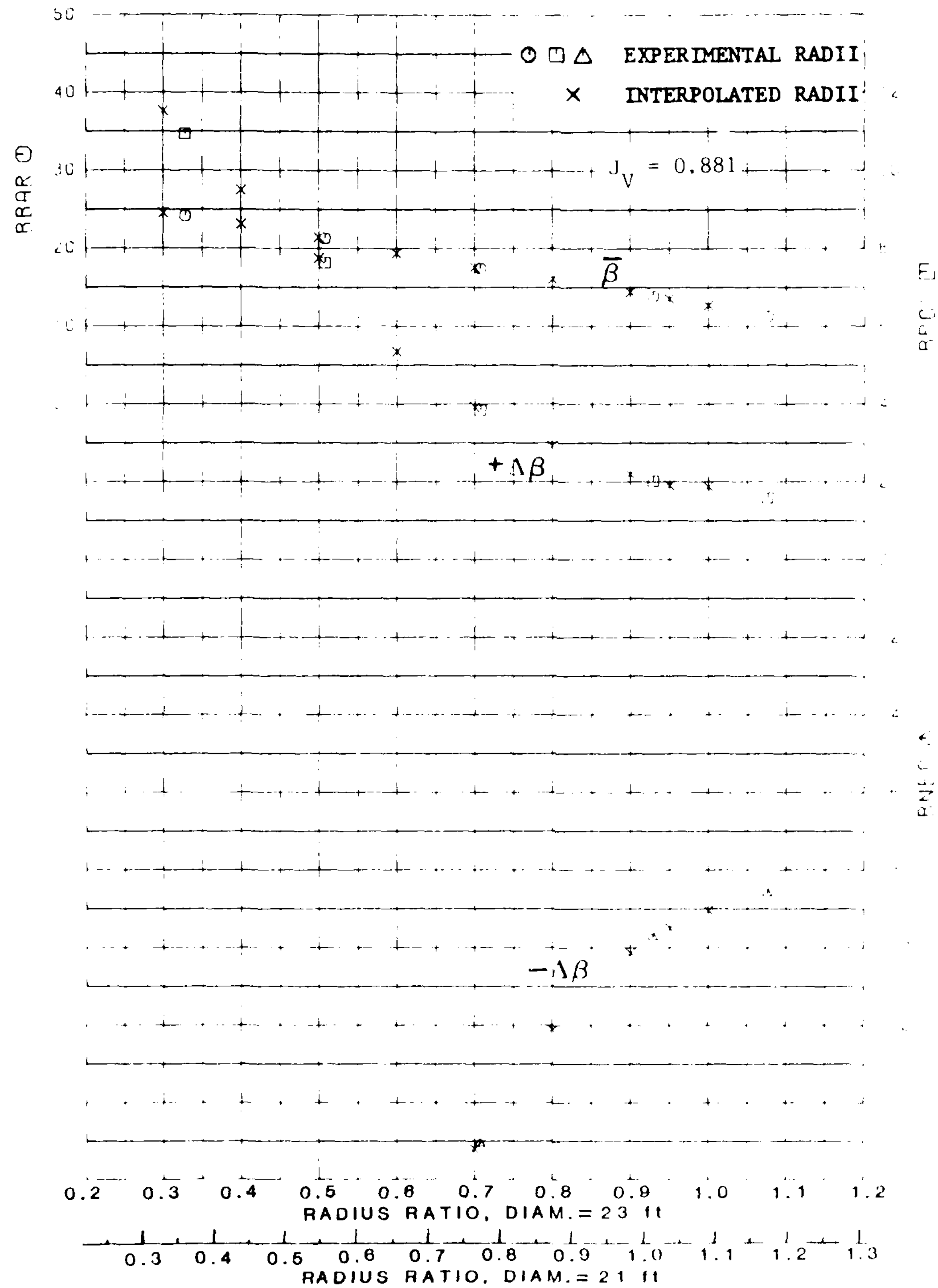


Figure D7 - RADIAL DISTRIBUTION OF THE MEAN ADVANCE ANGLE AND THE MAXIMUM VARIATIONS OF THE ADVANCE ANGLE FOR MODEL [illegible]
EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT [illegible] TONS

Table D1 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES
EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS
D = 21 ft (6.4 m), $J_V = 1.01$

RADIUS =	.354	.556	.774	1.017	1.176	.200	.300	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	.528	.705	.792	.821	.758	.316	.456	.572	.664	.727	.769	.801	.823	.823
VTBAR =	.007	-.000	.001	.000	.005	.020	.011	.005	.001	.000	.001	.000	-.000	.000
VRBAR =	.078	.038	.047	[illegible]	.043	.143	[illegible]	.066	.045	.042	.046	.043	.033	.030
1-WVX =	[illegible]	[illegible]	[illegible]	[illegible]	.740	0.000	[illegible]	[illegible]	.533	[illegible]	.636	.673	.704	.728
1-WX =	.453	[illegible]	[illegible]	[illegible]	.747	0.000	.401	.465	.532	.590	.637	.675	.705	.729
BBAR =	25.15	22.19	18.1[illegible]	14.[illegible]5	11.53	[illegible]6.21	25.73	[illegible]	23.12	21.24	19.44	17.84	16.39	14.82
BPOS =	11.[illegible]5	7.42	4.[illegible]3	2.13	1.64	24.18	17.80	1[illegible].48	8.74	6.73	4.92	3.76	2.88	2.22
THETA =	[illegible]	[illegible]	[illegible]	77.[illegible]	[illegible]	222.50	[illegible]	112.50	107.50	97.50	80.00	77.50	77.50	77.50
BNEG =	-18.95	-17.85	-15.75	-10.17	[illegible]	-34.90	-14.15	-14.11	-18.62	-17.56	-16.85	-14.81	-12.09	-10.33
THETA =	0.00	2.50	[illegible]	0.00	0.00	50.00	0.00	2.50	2.50	0.00	0.00	0.00	0.00	0.00

[illegible]
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

Table D2 - HARMONIC ANALYSIS OF LONGITUDINAL VELOCITY COMPONENT RATIOS
AT THE EXPERIMENTAL RADII
EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359								
AMPLITUDE =	-.2407	-.1372	.0678	-.0269	.0001	-.0119	.0051	-.0031
RADIUS = .558								
AMPLITUDE =	-.2147	-.2466	-.0063	-.0605	.0351	-.0366	.0197	-.0265
RADIUS = .774								
AMPLITUDE =	-.1970	-.1938	-.0742	-.0751	.0143	-.0295	.0221	-.0279
RADIUS = 1.017								
AMPLITUDE =	-.1826	-.1422	-.0886	-.0576	-.0221	-.0204	-.0066	-.0127
RADIUS = 1.178								
AMPLITUDE =	-.1790	-.1250	-.0891	-.0574	-.0323	-.0214	-.0146	-.0091

AD-A097 930 DAVID W TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CE--ETC F/G 20/4
MEASUREMENTS OF THE EFFECT OF TRIM ON THE NOMINAL WAKE OF THE N--ETC(U)
MAR 81 M B WILSON, G A HAMPTON
UNCLASSIFIED DTNSRDC/SPD-0544-19 NL

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Table D3 - HARMONIC ANALYSIS OF LONGITUDINAL VELOCITY COMPONENT RATIOS
AT THE INTERPOLATED RADII
EXPERIMENT 4

TRIMMED [illegible] FEET BY THE BOW, DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200								
AMPLITUDE =	-.2687	.0600	.1357	.0144	-.0655	.0296	-.0153	.0311
RADIUS = .300								
AMPLITUDE =	-.2504	-.0754	.0921	-.0131	-.0204	.0012	-.0016	.0080
RADIUS = .400								
AMPLITUDE =	-.2345	-.1723	.0515	-.0355	.0116	-.0195	.0091	-.0097
RADIUS = .500								
AMPLITUDE =	-.2212	-.2307	.0138	-.0530	.0303	-.0326	.0168	-.0220
RADIUS = .600								
AMPLITUDE =	-.2106	-.2354	-.0240	-.0658	.0318	-.0353	.0223	-.0279
RADIUS = .700								
AMPLITUDE =	-.2025	-.2110	-.0569	-.0733	.0226	-.0320	.0242	-.0290
RADIUS = .800								
AMPLITUDE =	-.1949	-.1868	-.0765	-.0722	.0092	-.0279	.0181	-.0258
RADIUS = .900								
AMPLITUDE =	-.1881	-.1632	-.0837	-.0635	-.0078	-.0232	.0047	-.0186
RADIUS = 1.000								
AMPLITUDE =	-.1832	-.1448	-.0881	-.0582	-.0204	-.0206	-.0052	-.0134

Table D4 - HARMONIC ANALYSIS OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RATIOS EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.0330	-.0120	.0556	-.0100	.0209	-.0033	.0069	-.0027
RADIUS = .556 AMPLITUDE =	-.1073	-.0268	.0157	-.0003	.0184	-.0139	.0104	-.0098
RADIUS = .774 AMPLITUDE =	-.1246	-.0364	-.0103	.0010	.0075	-.0017	.0068	-.0094
RADIUS = 1.017 AMPLITUDE =	-.1205	-.0493	-.0244	-.0056	-.0042	-.0003	-.0017	-.0009
RADIUS = 1.178 AMPLITUDE =	-.1272	-.0625	-.0323	-.0136	-.0105	-.0067	-.0059	-.0031

Table D5 - HARMONIC ANALYSIS OF TANGENTIAL VELOCITY COMPONENT RATIOS
AT THE INTERPOLATED RADII
EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	.0676	.0042	.0992	-.0236	.0179	.0203	-.0004	.0082
RADIUS = .300 AMPLITUDE =	.0001	-.0064	.0706	-.0144	.0203	.0039	.0047	.0008
RADIUS = .400 AMPLITUDE =	-.0531	-.0155	.0460	-.0073	.0209	-.0072	.0082	-.0047
RADIUS = .500 AMPLITUDE =	-.0919	-.0232	.0254	-.0023	.0198	-.0130	.0100	-.0085
RADIUS = .600 AMPLITUDE =	-.1124	-.0286	.0094	.0005	.0161	-.0106	.0100	-.0103
RADIUS = .700 AMPLITUDE =	-.1209	-.0329	-.0029	.0013	.0111	-.0047	.0084	-.0103
RADIUS = .800 AMPLITUDE =	-.1233	-.0373	-.0120	.0006	.0061	-.0009	.0058	-.0078
RADIUS = .900 AMPLITUDE =	-.1203	-.0420	-.0179	-.0016	.0011	.0006	.0020	-.0032
RADIUS = 1.000 AMPLITUDE =	-.1202	-.0481	-.0235	-.0049	-.0035	-.0000	-.0012	-.0010

Table D6 - INPUT DATA FOR WAKE SURVEY ANALYSES
EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS

RADIUS = .324

ANGLE	VX/V	VT/V	VR/V
-.3	.122	.001	-.006
3.2	.178	.011	-.005
12.2	.205	.041	.131
21.2	.231	.043	.092
29.1	.245	.045	.077
37.0	.301	.026	.050
51.6	.351	-.016	.043
64.1	.456	-.034	.053
64.2	.433	-.035	.045
78.6	.558	-.054	.072
89.5	.627	-.077	.085
93.1	.655	-.073	.092
112.9	.788	-.049	.115
120.3	.763	-.040	.122
132.9	.786	.009	.124
150.8	.707	.056	.102
152.6	.647	.054	.094
163.2	.643	.082	.050
165.9	.612	.080	.023
172.4	.559	.067	-.000
175.9	.528	.056	-.013
179.6	.515	.042	-.017
183.2	.510	.002	-.021
188.6	.499	-.073	-.015
192.2	.541	-.073	.004
195.9	.562	-.042	.025
210.1	.679	-.055	.094
240.6	.794	.048	.117
271.4	.646	.075	.095
296.7	.425	.065	.054
307.5	.376	.044	.062
319.9	.351	.015	.051
332.5	.260	-.016	.082
339.8	.220	-.044	.099
348.7	.228	-.027	.125
354.0	.251	-.003	.127
359.7	.122	.001	-.005

RADIUS = .508

ANGLE	VX/V	VT/V	VR/V
-.6	.149	.018	-.005
3.1	.137	-.005	.071
8.7	.246	-.006	.134
12.1	.271	-.002	.098
15.7	.306	-.022	.087
30.0	.433	-.060	.010
60.6	.810	-.141	-.013
91.4	.938	-.107	.007
116.7	.944	-.074	.045
127.5	.924	-.071	.060
140.0	.920	-.053	.078
152.6	.878	-.016	.099
161.5	.779	.031	.105
167.0	.660	.067	.062
172.3	.554	.075	.009
176.0	.521	.070	-.021
179.5	.452	.047	-.045
179.7	.455	.019	-.058
183.4	.471	-.006	-.044
188.7	.583	-.051	.007
192.1	.648	-.063	.044
201.1	.819	-.011	.110
208.4	.856	.026	.108
220.7	.871	.046	.090
231.6	.893	.059	.073
244.1	.896	.079	.052
269.5	.892	.112	.011
300.3	.719	.126	.003
330.6	.390	.041	.032
343.2	.282	.030	.099
348.6	.266	.002	.124
352.2	.186	.013	.145
355.9	.147	.002	.017
359.4	.149	.018	-.006

RADIUS = .707

ANGLE	VX/V	VT/V	VR/V
-.3	.120	.002	.034
1.2	.121	.002	.034
3.0	.257	-.012	.153
5.0	.270	-.010	.149
8.6	.296	-.034	.103
12.1	.356	-.042	.082
19.4	.347	-.055	.040
28.3	.545	-.059	-.004
40.8	.710	-.129	-.039
51.5	.848	-.147	-.049
64.2	.913	-.137	-.024
89.4	.925	-.117	.035
120.1	.926	-.079	.077
149.0	.932	-.046	.096
163.2	.929	-.030	.104
168.6	.929	.002	.115
172.2	.888	.048	.120
175.9	.718	.096	.067
177.8	.654	.092	.026
179.5	.607	.086	.003
181.5	.531	.018	-.023
183.2	.539	-.041	-.020
188.5	.687	-.085	.069
192.1	.848	-.040	.122
195.8	.921	.018	.115
210.0	.934	.047	.102
240.6	.925	.073	.080
271.3	.920	.109	.042
294.8	.903	.140	-.013
307.4	.846	.153	-.034
320.0	.709	.138	-.025
332.5	.520	.082	.015
339.7	.446	.073	.034
348.5	.317	.045	.097
352.1	.291	.046	.129
355.7	.269	.040	.145
357.5	.231	.018	.213
359.7	.120	.002	.038

CONTINUED

Table D6 - INPUT DATA FOR WAKE SURVEY ANALYSES
EXPERIMENT 4

TRIMMED 3.5 FEET BY THE BOW, DISPLACEMENT 26,390 TONS

RADIUS = .924

ANGLE	VX/V	VT/V	VR/V
-.5	.244	.007	.139
1.5	.254	-.035	.131
3.1	.289	-.058	.123
3.2	.294	-.036	.118
8.5	.355	-.062	.070
12.1	.429	-.082	.039
15.7	.450	-.088	.015
15.8	.501	-.100	.009
30.0	.676	-.143	-.055
60.6	.885	-.138	-.025
91.3	.917	-.095	.036
91.4	.910	-.094	.039
116.7	.921	-.064	.057
116.8	.923	-.065	.057
127.4	.931	-.054	.062
127.5	.920	-.053	.063
140.0	.933	-.042	.066
140.0	.926	-.042	.067
152.6	.927	-.032	.066
159.7	.936	-.026	.064
161.5	.933	-.024	.065
168.5	.933	-.023	.062
172.1	.934	-.019	.062
172.3	.932	-.017	.063
175.7	.927	.023	.086
177.5	.860	.050	.106
179.5	.768	.037	.087
181.2	.788	-.017	.083
183.0	.851	-.042	.082
183.4	.868	-.042	.090
185.0	.909	-.013	.096
188.6	.932	.027	.071
188.7	.928	.028	.073
192.1	.933	.031	.071
192.1	.925	.031	.070
199.4	.929	.035	.072
208.3	.931	.040	.072
220.8	.932	.050	.069
220.7	.920	.050	.070
231.5	.929	.058	.065
231.8	.921	.059	.065
244.1	.915	.072	.060
244.2	.926	.071	.060
269.4	.926	.100	.036
269.5	.915	.100	.041
300.3	.898	.140	-.023
330.6	.651	.126	-.041
343.2	.448	.083	.023
343.2	.464	.070	.027
348.6	.413	.063	.056
348.6	.385	.061	.065
352.2	.316	.055	.092
352.2	.326	.049	.100
355.9	.275	.046	.130
355.9	.285	.048	.121
357.8	.251	.036	.137
359.4	.275	-.009	.139
359.5	.244	.007	.139

RADIUS = 1.076

ANGLE	VX/V	VT/V	VR/V
-.3	.182	.046	.125
3.2	.206	-.035	.121
8.7	.302	-.096	.067
12.2	.379	-.105	.040
21.2	.516	-.127	-.016
28.1	.600	-.150	-.045
39.0	.720	-.159	-.055
51.6	.764	-.153	-.025
64.1	.812	-.138	.014
64.2	.827	-.139	.014
78.6	.834	-.119	.046
89.5	.837	-.103	.062
93.1	.836	-.094	.065
112.9	.845	-.065	.079
120.3	.850	-.059	.082
132.9	.855	-.045	.084
150.8	.864	-.028	.085
152.6	.859	-.027	.085
163.2	.869	-.019	.084
166.9	.874	-.014	.081
172.4	.874	-.008	.078
175.9	.876	-.003	.074
179.6	.873	.005	.070
183.2	.880	.013	.070
188.6	.871	.020	.075
192.2	.876	.025	.080
195.9	.878	.025	.080
210.1	.886	.038	.082
240.6	.874	.065	.075
271.4	.864	.105	.052
295.7	.844	.149	.010
307.5	.812	.160	-.020
319.9	.750	.168	-.052
332.5	.602	.160	-.039
339.8	.501	.152	-.016
348.7	.366	.108	.046
352.4	.288	.104	.071
356.0	.264	.093	.097
359.7	.182	.046	.125

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